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THE

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THE PRICE OF ELECTRICAL ENERGY IN NEW YORK.

THE American *Electrical Engineer* of October 13th contains an interesting article on the reduction of the prices charged by the Edison Company of New York to its consumers.

The article commences as follows:—

"Consistently with its intelligent and well-matured policy of lowering the price of current to all consumers as fast as the growth of the business and progressive economies in current production would allow, the Edison Electric Illuminating Company has now made further reduction in its regular charges."

The above paragraph makes such very pleasant reading that one hurries on to ascertain what it amounts to in plain figures. Our first thought is to remove to New York in order to obtain the blessings of cheap electricity; but after mastering the details of the schedule, our second thoughts are that there are worse places than London.

The system of charging is an imitation of the "Wright system," but without the demand indicator, that is to say, the price is varied according to the number of hours' use per diem of the maximum possible requirement, consequently the consumer has no interest in reducing the peak of the load curve.

The price for the first hour's average daily use is 10d. per unit; for the second hour's use, 7½d.; for the third and fourth hour, 5d.; and for all beyond, 2½d.

The New York householder is now probably gloating over the final figure of 2½d.; but he will not gloat much when he sees his bill; he will find that his winter limit will be 7½d., and in the summer he will get nothing under 10d.

For wholesale use, with a guarantee of 2,000 units per month, and two hours' average daily use, the price is 5d. per unit for the first four hours, and 2½d. per unit afterwards.

To encourage cooking, heating, &c., by electricity, household apparatus for these purposes are excluded in calculating the maximum possible demand.

This is very curious, for if the object of the company were to be attained on those terms, they would find their load peak would at dinner time rise to three times its present height, and as low temperatures and long nights come at the same time of the year, their load factor would be diminished. On the other hand, we cannot imagine that any but a few millionaires will adopt electrical cooking and heating, even at 5d. or 2½d. per unit.

It would be very interesting to ascertain how it comes about that these high prices are necessary in New York. Is it due to the high price of labour or to water in the capital?

In tramway enterprise we are a long way behind the New World, but in the distribution of cheap electricity, we have evidently nothing to learn from New York.

D

GAS TRACTION.

Considering the constant obstruction to electric traction and its initial outlay, it is a little remarkable that gas traction has not made greater progress. At an electric generating station there must be more power than is consumed by the cars along a line.

In a gas system the central station is only called on to compress the power gas into cylinders. No power is generated, and the compression only requires a very small percentage of the power locked up in the gas in the form of chemical energy to be liberated by combustion. *Trade and Industry* publishes an article on the system at Blackpool, whence it appears that the service to St. Annes has been very satisfactory during the past season. The line is to be doubled. Started in 1896 with four cars, 12 more were added of larger size, seating 52 passengers instead of 40. The line is worked by the British Gas Traction Company on the basis of 5¼ per car mile. The line, 7¾ miles long, has four passing places per mile, and there are two compressing stations about a mile from the termini. Gas costs 2s. 4d. per 1,000 feet. The large cars consume about 35 feet of gas per car mile at a cost of nearly one penny. This includes the gas used by the compressors—about 11 per cent. of the whole.

In April last another gas line was opened between Stretford and Barton-upon-Irwell—some 3¼ miles in length. This is a light railway suitable for carrying goods from the Salford Docks. The gas consumption is even less than at Blackpool. Neath has now adopted the system and two light railways are to be worked on the gas system, the latter being under construction in the West of England. Our contemporary compares the various modes of tramway traction by cable, steam, the Serpollet system, the Mekarski with its 900 lbs. air pressure and ice trouble, the accumulator and the trolley system, the latter being honoured with the heaviest condemnation, perhaps because the most formidable, in the shape of electrolysis and signal disturbance. In Holland, a gas car has run as much as 21 miles on a single charge of gas; but 10 to 12 miles is usual. The jacket cooling water is renewed when the gas reservoir is recharged, and the two operations need not occupy more than a few seconds. It is claimed that the cars are not audible, at the same distance as an electrical trolley car.

For a line of 12 miles the compressing station need not exceed in cost about £3,000 for plant and buildings. It would run 20 to 25 cars, and the total cost of the whole line, with equipment, would not be £60,000—a sum less than the cost of the line alone with conduit or cable systems. Electric traction, with cars of 40 or 50 passengers, requires 1 kilowatt per car mile, costing 2d. to 3d.

The gas traction system would undoubtedly move ahead rapidly, were it not that the public are in an expectant mood as regards electrical working, and the way is being blocked by the municipalities. Electrical traction is suffering from narrow-mindedness, and the cost of it is inordinately heavy because it is being exploited in a niggling manner. Gas traction is suited equally with electricity for both local and general lines, wherever gas is to be bought along an extended route at suitable distances.

Electricity is a little costly to manufacture by means of coal, and the success of electricity depends very much upon broad views, and a capacity to utilise bye-products in the shape of the heat of the waste steam, as well as to generate electricity by gas power, either by the use of producer gas from cheap inferior coals, or by utilising that huge stream of now wasted energy which flows day and night from every blast furnace, and which would drive every tramway in the country, and leave a large surplus of power for other purposes.

The Physical Society Meeting.

The Physical Society held their first meeting of the new session on Friday last at Burlington House. Although there was nothing of striking importance in the papers read, there was plenty of evidence that the Fellows had spent some of their very long vacation in serious work. Mr. Pidgeon exhibited an influence machine of the Holtz-Wimshurst type, to which he has added auxiliary inductors, and a coating of wax to the glass discs. But he rather failed in his attempt to demonstrate the theory of the working of these additions; and it was difficult, from his very qualitative experiments, to judge how far the output was increased by them. Before any definite opinion can be come to, it will be necessary to know the comparative cost, weight, complication, and output of the machine, and also whether it is quite free from the "reversing" tendency. One great merit of Mr. Pidgeon's influence machine he certainly did establish, *i.e.*, its absolute immunity from the evils arising from surface moisture and dust. This immunity is chiefly obtained by coating the sectors with an insulating substance, and by restricting the exposed surface to a very small area. The mixture of paraffin wax and resin adopted by Mr. Pidgeon does not commend itself to us, however. For although the surface repels moisture at first, the wax itself slowly absorbs it; moreover, this resinous mixture retains the electrical charges, which means that electrical work is wasted at each reversal. There are mica substitutes that would seem to obviate both these defects, presenting at the same time mechanical and electrical advantages. Experiments on physical subjects, whether original or not, are always welcome at these meetings; it is true they take up the time, but everybody agrees that the time is well spent. This was the case when Dr. S. P. Thompson exhibited the remarkable magneto-optical experiments of Righi. They form a supplement to those of Zeemann, and the two constitute a perfect complement to the magneto-polarioscopic work of Faraday. Mr. Albert Campbell's paper on "The Magnetic Fluxes in Meters and other Electrical Instruments" is of far-reaching usefulness, and deserves careful study in detail. The smallness of the forces measured, and the extreme narrowness of the gaps, necessitated modifications of tests and improved methods. Mr. Campbell gives us the magnetic fluxes for a range of instruments including such various fields as those of the Siemens dynamometer, the Thomson galvanometer, the Weston voltmeter, the Evershed ohmmeter, and the Bell telephone; and he follows this up with a critical examination of many standard forms of electricity meters. The discussion of his paper is adjourned to the next meeting of the Physical Society, to be held at Burlington House at 5 p.m. on Friday, November 11th; no doubt our readers will be glad of this opportunity of a closer acquaintance with the subject. By the way, the discussion of a paper on "The Magnetic Properties and Electrical Resistance of Iron," by Dr. D. K. Morris, was adjourned as far back as May, 1897; perhaps some Fellow of the Physical Society can tell us what has become of it.

THE ELECTRICAL SOLAR HYPOTHESIS.

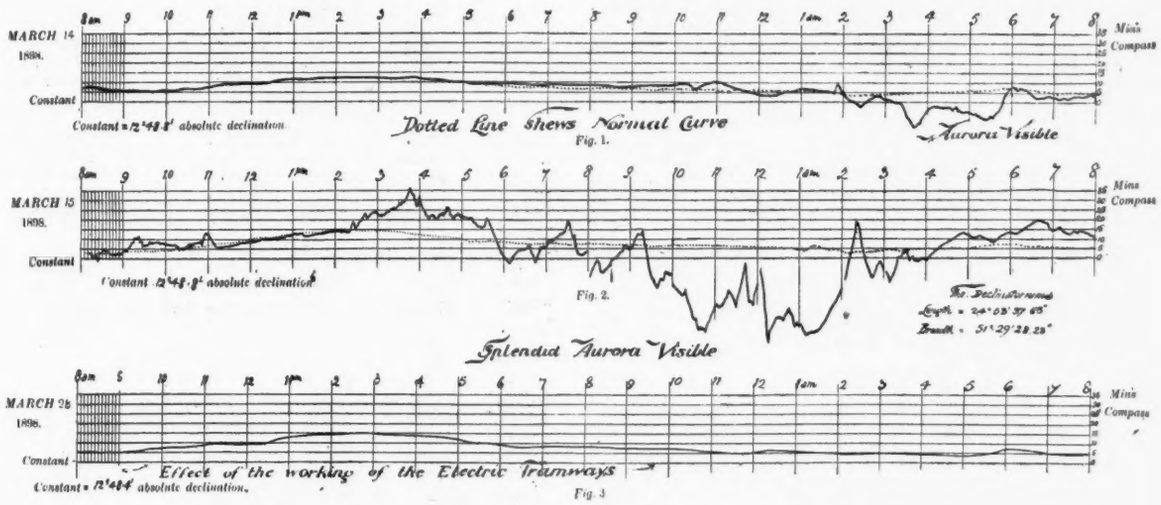
Additional Correlative Evidence.

By DELTA.

Since the first series of articles appeared, the author has had the opportunity of examining the magnetic observatories which are under the control of Herr Lenz. These observatories are situated in the Stadt Park, Bochum, Prussia.

Thanks to Herr Lenz, the author is able to exhibit copies of the curves of magnetic declination. The registration is effected continuously all through the year by the autophotographic system. Figs. 1 and 2 show the curves of magnetic declination for the two days, March 14th and 15th of this year.

On both dates *an aurora of great splendour was visible* at Bochum and throughout Europe, and on these days spots were visible on the sun's surface; the violent magnetic perturbations suggest a distinct association between the solar spots, the aurora, and the condition of terrestrial magnetism; and this association will always be found to exist, contributing evidence of great and irrefutable value in favour of the author's electrical solar hypothesis.



On referring to the author's former articles, it will be seen that the electrical hypothesis therein advanced assumes that the sun spots constitute the solar surfaces that absorb electrical energy from the interplanetary space, and, in a degree, to compensate for that distributed to the planetary and stellar bodies. The intrusion of these electrical energy absorbing surfaces must obviously affect both the electrical potential of the earth's atmosphere, and also the terrestrial magnetism, but only on the terrestrial surfaces that are in a position of solar electrical reception. We see evidence of this disturbing effect of sun spots on the curves of all the diagrams at all periods where sun spots are in evidence. The violent magnetic perturbations are very conspicuous. In order to show the degree of variation from the normal, the author has marked in dotted lines, on the curve, the average line representing the normal range of declination.

Fig. 3 shows quite clearly the influence of the effect of the electric earth current returns of the Bochum electrical tram system on the needle.

A careful examination of the day-by-day curves of 2½ years shows a wonderful regularity in the degree effect on the needle of the electric tram system, and it should not be difficult to arrange a formula of correction.

The author, in a future note, will give further and still more recent evidence of correlation in proof of the solar and electrical hypothesis and its associated phenomenon.

CALCULATIONS FOR ELECTRIC LIGHT WIRING.*

It is very desirable that every man having charge of a power or machinery plant should be familiar with the use of wiring tables, and when the occasion demands it, he should be able to compute the size of wire required for various purposes with a fair degree of accuracy. In Table I. we have combined two standard wiring tables, omitting such portions as are unnecessary in ordinary calculations, and which must from their nature be more or less inaccurate, and have given only those parts which are involved in everyday work.

The fourth column in the table is particularly useful in reducing the area of a conductor of rectangular section to its equal in round wire. Suppose we had a strip of copper ·004 inch thick and 1 inch wide, and wanted the size of wire having approximately the same sectional area. The area of the strip would be 1,000 × 4 = 4,000 square mils. Referring to the table we find that No. 13 wire has an area of 4,067·1 square mils, which is the nearest to the required area. Column 5 giving the weight of 1,000 feet of the various sized wires is used for calculating the weight of the wire used in armature and field coils and also in plants.

When it is desired to find the weight of wire for a system of feeders or for long supply wires in incandescent circuits, column 6 will be found much more convenient, giving the weight in larger units or in pounds per mile. Columns 8 and 9 giving the resistances at different lengths are very important. When calculating for rheostats, resistance boxes, Wheatstone bridges, and other measuring instruments, we have given a known resistance and require the amount of a certain sized wire having that same resistance, column 10 will be found especially applicable.

Suppose it is desired to find the size of wire required in a certain building where the conditions are as follows: 16 C.P. lamps are to be used requiring ·6 ampere at 110 volts, the loss being not more than 2 volts on any circuit at full load. There are five different circuits in this mill, each one requiring a different size of wire according to the conditions given in Table II. We will give the complete calculation for circuit 1.

For the sake of clearness we will tabulate our results as shown in Table II. There are 40 lights in circuit 1, requiring 40 × ·6 = 24 amperes, and since the lights are 65 feet from the switchboard, a total of 130 feet of conductor will be required.

To find the resistance of this conductor, Ohm's law must be applied, which is $R = \frac{E}{C}$; thus $R = \frac{2}{24} = \frac{1}{12} = ·0833$ ohms. The problem now is to find such a size of wire of

* New York *Engineer*.

which 130 feet will have a resistance of ·0833 ohms. If 130 feet have a resistance of ·0833 ohms, 1,000 feet will have a resistance of $\frac{1,000}{130} \times \frac{1}{12} = \frac{25}{39} = ·641$ ohms. Now, referring to Table I., we find that No. 8 wire has a resistance of ·62881 ohms per 1,000 feet, which is the nearest to the required size, hence we select a No. 8 wire. In Table I., No. 8 wire has a weight of 49 88 lbs. per 1,000 feet. Then 130 feet of the wire will weigh $\frac{130}{1,000}$ of 49·88 = 6·48 lbs.

The other circuits are calculated the same way, and in order that the reader may acquire a little practice along this line if he so chooses, we give in Table II. the results obtained for the other four circuits.

It is required to find the most economical size of conductor to use in transmitting current for 1,200 lights or 720 amperes from a waterfall to a mill 1,000 feet away.

If 2 volts loss were allowable, the resistance of the 2,000 feet of conductor would be $\frac{2}{720} = \frac{1}{360}$ ohms, or for 1,000 feet would be $\frac{1}{720} = ·0014$ ohms. This resistance is much larger than that of a single 0000 wire, and to obtain the number of 0000 wires required, we divide the resistance of one 0000 wire, ·0490 by the given resistance ·0014 which gives 35 0000 wires.

By referring to column 5, Table I., we find that the weight of one 0000 wire per 1,000 feet is 639·33 lbs. Then the weight of 35 0000 wires would be 35 × 2 × 639·33 = 44,753·10 lbs. At the current price of copper this would be a very expensive installation, and the only way to reduce it would be to allow more voltage to be lost in the conductor; that is, by using a single 0000 wire we would have to make the volts lost = 35 × 2 = 70 volts. Then the voltage at

TABLE I.—SIZES, WEIGHTS, AND RESISTANCES OF COPPER WIRE.

1	2	3	4	5	6	7	8	9	10	11
	UNINSULATED WIRE.						PURE COPPER AT 75 DEGREES FAHRENHEIT.			
Gauge.	Diameter in mils.	Circular mils. (D^2) mil. = ·001 inch.	Square mils. (D^2 × ·7854.)	Pounds per 1,000 feet.	Pounds per mile.	Feet per pound.	R. or ohms per 1,000 feet.	Ohms per mile.	Feet per ohm.	Ohms per pound.
0000	460 000	211,600	166,190	639·33	3,375·7	1·56	·04906	·25903	20,383	·000076736
000	409·640	167,805	131,790	507·01	2,677	1·97	06186	·32664	16,165	·00012039
00	364 800	133,079 4	104,520	402·09	2,123	2·49	·07801	·41157	12,820	·00019423
0	324 950	105,592 5	82,932	319·04	1,68‹ 5	3 13	·C9831	·51909	10,409	·00030772
1	289 300	83,694·2	65,733	252·88	1,335·2	3·95	·12404	·65490	8,062·3	·00048994
2	257·630	66,373	52,130	200 54	1,058 8	4·99	·15640	·82582	6,393·7	·00078045
3	229 420	52,634	41,339	159·03	839·68	6·29	·19723	1·0414	5,070·2	·0012406
4	204·310	41,742	32,784	126 12	665·91	7 93	·24869	1·3131	4,021 0	·0019721
5	181·940	33,102	25,998	100 01	528 05	10	·31361	1·6558	3,188 7	·0031361
6	162 020	26,250 5	20,617	79 32	418 81	12 61	·39546	2·0881	2,528·7	·0049868
7	144 280	20,816	16,349	62 90	332 11	15·9	·49871	2·6331	2,005·2	·0079294
8	128 490	16,509	12,966	49·88	263 37	20·05	·62881	3·3201	1,590·3	·012608
9	114·430	13,594	10,284	39·56	208·88	25·28	·79281	4·1860	1,261·3	·020042
10	101·890	10,381	8,153 2	31·37	165·63	31·38	1	5 2800	1,000·0	·031380
11	90·742	8,234	6,467	24 88	137 37	40 20	1·2607	6·6568	793·18	·050682
12	80·808	6,529·9	5,128 6	19·73	104 18	50 69	1·5898	8·3940	629·02	·080585
13	71 961	5,178·4	4,067·1	15·65	82·632	63·91	2 0047	10·585	498·83	·12841
14	64·084	4,106 8	3,146 9	12·41	65·525	80 59	2·5908	13·680	385·97	·20880
15	57 068	3,256·7	2,557 8	9·84	51·956	101·63	3·1150	16·477	321·02	·31658
16	50 820	2,589·9	2,028 6	7 81	41·237	128 14	4·0191	21·221	248·81	·51501
17	45 257	2,048·2	1,608 6	6·19	32·683	161·59	5·0683	26·761	197·30	·81900
18	40 303	1,624·3	1,275·7	4·91	25·925	203 76	6 3911	33·745	156·47	1·3024
19	35·390	1,252 4	983 64	3 78	20·051	264·26	8 2889	43·765	120·64	2·1904
20	31·961	1,021·5	802·28	3·09	16·315	324	10·163	53·658	98 401	3·2926
21	28·462	810 1	636·25	2·45	12·936	408·56	12 815	67·660	78·037	5·2355
22	25·347	642·7	504 78	1·94	10·243	515·15	16 152	85·283	61·911	8·3208
23	22·571	509·45	400·12	1·54	8·1312	649·66	20 377	107·59	49 087	13·238
24	20·100	404·01	317 31	1·22	6·4416	819·21	25 695	135·67	38 918	21·050
25	17 900	320 4	251·64	·97	5·1216	1,032·96	32·400	171·07	30·864	33·466
26	15·940	254·01	199 5	·77	4 0656	1,302 61	40 868	215·79	24·469	53·235
27	14 195	201 5	158 26	·61	3·2208	1,642 ·5	51·519	272·02	19·410	84·644
28	12·641	159·79	125·59	·48	2·5344	2,071·12	64·966	343·02	15·393	134·56
29	11·257	126 72	99·526	·38	2·0064	2,611·82	81 921	432·54	12·207	213·96
30	10·025	100·5	78·933	·30	1·5840	3,293·97	103 30	545·39	9 6812	340·25
31	8·928	79·71	62 604	·24	1 2672	4,152·22	127·27	671·99	7·8573	528·45
32	7 950	63·2	49·637	·19	1·0032	5,236·66	164 26	867·27	6·0880	860·33
33	7·080	50·13	39 372	·15	·7920	6,602 71	207 08	1,093·4	4·8290	1,367·3
34	6·304	39·74	31·212	·12	·6336	8,328 30	261·23	1,379·3	3 8281	2,175·5
35	5 614	31 52	24·756	·1	·5280	10,501·35	329 35	1,738·9	3·0363	3,458·5
36	5 000	25	19·635	·08	·4224	13,238 83	415 24	2,192·5	2·4082	5,497·4
37	4·453	19·83	15·567	06	·3168	16,691 06	523 76	2,765·5	1·9093	8,742·1
38	3 965	15·72	12 347	·05	·2640	20,854·65	660·37	3,486·7	1·5143	13,772
39	3·531	12·47	9 7939	·04	·2112	26,302 23	832·48	4,395·5	1·2012	21,896
40	3 144	9 89	7·7676	·03	·1584	33,175·94	1,049·7	5,542·1	·9527	34,823

the dynamo would have to be about 172 volts to allow for this loss and the loss in the wiring of the mill.

If power is cheap, it will be more economical to use a smaller wire and waste more power, and *vice versâ*. The best plan, however, is to follow Lord Kelvin's rule. The maximum economy is obtained by making the interest on the cost of the copper invested equal the cost of the power required to force the current through the conductors.

Suppose the cost of the power to be 40 cents per month per H.P., interest 6 per cent., and cost of copper 15 cents per pound, in the case given above. What will be the most economical size of conductor to use?

The weight of 2,000 feet of 0000 wire is 1,279 lbs. Cost = \$.15 × 1,279 = \$191.85. Interest at 6 per cent. = \$191.85 × .06 = \$11.51 per year, or \$.96 per month.

TABLE II.

1	2	3	4	5	6	7	8	9	10
No. of circuits.	No. of lights.	No. of amperes.	Distance from switchboard.	Heat of conductor required.	Volts lost.	Resistance.	R. per 1,000 feet.	Size of wire.	Weight.
1	40	24·	65	130	2	·0833	·641	8	6 48
2	16	9·6	316	632	2	·2083	·3290	5	63·2
3	6	3·6	1,120	2,240	2	·5555	·2530	4	282 5
4	88	52 8	105	210	2	·0360	·1714	2	42·1
5	125	75·	40	80	2	·0266	·3325	5	8·

According to the formula derived from Ohm's law, Watts = C E = 70 × 720 = 50.400. H.P. = watts ÷ 746 = 50,400 ÷ 746 = 67·56 H.P. The price of the power will be \$.40 × 67·56 = \$27.03 per month. That is, the power costs $\frac{27·03}{·96}$ = 28·1 times as much as the interest. The square root of this ratio between the interest and the cost of the power will give the proper number of conductors to use.

The square root of 28·1 = 5·3 0000 wires.

With 5·3 0000 wires the cost will only be \$27.03 ÷ 5·3 = \$5.1 per month, and the interest will be 5·3 × \$.96 = \$5.1. Therefore, if 720 amperes were to be carried all the time, a circuit 5·3 times as large in cross-section would give the greatest economy.

By referring to the table of safe-carrying capacities in the National Electrical Code, we find that this size of wire is very nearly correct, the size there given being 1,200,000 circular mils for 730 amperes. The entire code was published in this paper last fall, and is now published in vest pocket form by the Board of Underwriters, and can be obtained from any insurance agency in one's city or district. It is very desirable that everyone should possess a copy of this code.

ANDERSON'S SURFACE CONTACT ELECTRIC TRACTION SYSTEM.

THE surface contact system still has many attractions for inventors, and although in the past it has been pretty well worked out by many well-known engineers it has not so far come into practice. The trolley system is used on hundreds of successful lines, works and pays its way well, while surface contacts are only experimentally in use. But the adoption of numerous trolley systems may be due to a considerable extent to other causes than superiority of the system.

Corporations have a habit of following each other's examples, sometimes blindly, and the trolley system is pushed and worked by energetic companies with abundance of capital and skill at command.

The surface contact systems are not to be ignored simply because trolley systems are so numerous in comparison, for at one time in the history of electric traction there was only one trolley system in use, and numerous cable and horse lines, but, nevertheless, the trolley was the better system.

It is interesting to note that at the present moment two determined attempts are being made to establish the surface contact system, one in London by Prof. S. P. Thompson, and Anderson's in Leeds.

A general description of the construction and working of this system is as follows:—The invention is essentially a mechanical device for connecting the supply main to the motor by means of rising and falling studs worked by a skate under the car.

Hitherto the studs have been fixtures, and the connection made by means of electro-magnets somewhat uncertain in action. The mechanical method seems to get over this difficulty.

Along the centre of the track between the rails are fixed, at intervals of about 17 feet, cast-iron boxes 3 feet long by 1 foot wide and 1 foot 8 inches deep. The lids of these boxes are laid flush with the roadway setts. Connecting the boxes, at a depth of about 12 inches below the setts, are three-duct stone conduits. The boxes themselves are fitted with a simple arrangement of levers and catches, which actuates short cylindrical studs, enabling them to move up or down in a vertical direction.

When fully up, the tops of the studs are about 4 inches above the surface of the roadway; when down, they are flush with the same.

The levers are interconnected by means of wires passing through the top and bottom ducts of the above-mentioned stoneware conduits, and the mechanical arrangement is such, that, assuming a stud in any box to be raised, on pressing the same down, the stud in the next box forward is raised, and when this latter is in its turn pressed down, the process is repeated in the next box forward, and so on.

The top portion of each stud is made of phosphor-bronze, or some other good and, at the same time, durable, electrical conducting material, and connected to this is a spindle passing through the body of the stud, which is hollow, to a switch arm fixed to the lower portion of the stud below the box lid, but efficiently insulated from it. As the stud rises, but well after the top portion of it is clear of the lid of the box, this switch arm comes in connection with a fixed brass contact piece, mounted on a stoneware frame, which, in its turn, is clamped into oil cups to ensure insulation.

These contact pieces are all connected with one another, and one pole of the source of supply, by means of an insulated cable passing through all the boxes and the centre duct of the stoneware conduit between the boxes. It is thus evident that as long as any stud is up, the top insulated portion is in direct connection with the source of supply; but on being depressed its switch arm breaks connection with the contact piece, and the next stud forward is in its turn energised.

On the underside of the car is mounted a long rigid skate. The height of this skate above the roadway is such that the studs, when raised, will make contact with it, and its length is slightly in excess of the distance between the studs, so that before leaving contact with one it is in connection electrically with the next forward.

The back end of this skate is continued in the form of a long "ramp," having a gradual slant from the level of the skate to within half an inch of the surface of the roadway setts. This ramp is insulated from the skate by a space of some 6 inches, but to maintain an even pressure on the studs this space is fitted in with alternate strips of mica.

The system of workings is as follows:—

To start the car, the first stud is raised by hand or mechanically. Electric connection is then established from the insulated conductor through the switch and stud to the skate, and thence to the motors. Thus the car commences to move forward. The slanting ramp, pressing over the raised stud, presses the same down, breaking its electrical connection, but at the same time the next stud forward has been raised, and as the switches on the studs are so set that the one on the rising stud makes its connection before the one on the falling stud has broken contact, and the skate, as before stated, is long enough to press on two studs at once for a short time, there is no interruption of current to the motors, and the car continues its progress.

From the above it will be clear (1) that no stud can

possibly be raised until the car is over it, and (2) that no stud can be energised until it is raised; further, that there is little danger of the "ramp" failing to depress a stud, as it is the weight of the car itself that really acts on the stud, though a few pounds' pressure is found in practice to be enough to do the work. At the same time, in order to get over the difficulty of stones, &c., lying on the track, the "ramp" is held down by a powerful spring action, which would give rather than raise the car before any such obstacles.

It should be stated that the lifting and dropping of the studs is a spring action in both directions, the dead point being when the stud is half up. This has the effect of maintaining a continuous gentle pressure between the stud and the skate when up, and of causing the switch arm to break contact with a sharp spring action when the stud is being depressed.

There can scarcely be any uncertainty as regards pressing the studs home, when it is considered that the lowest portion of the "ramp" is only about half an inch above the top of the box.

To enable a bogie car to negotiate curves, the skate is hinged in the centre in such a manner, that it is impossible for it to break contact with its stud sideways.

No better guarantee of the safety of the system to the public and horses can be offered, it is claimed, than the fact that, on the half mile length of track on which the system is being experimentally tried, there is constant service of horse trams, and during the time in which the current has been frequently on, nothing in connection with the system has happened to interfere with the working of the horse tramway service.

The experience of frost and snow have still to be tried, but the promoters are sanguine that the system will prove itself workable in all weathers.

The mechanical arrangements seem to be brought to great perfection, and certainly offer a better system of connection than the electro-magnetic one.

But the electrical switches and contacts operated by such a mechanical arrangement will require careful and skilful working out. The electrical devices used on the experimental line are capable of considerable improvement, and improvements no doubt will be carried out before any extensive line is laid down.

It is not, strictly speaking, a closed conduit system, for every switch box in the ground has a surface opening through which the studs fit loosely, necessarily loosely.

On the other hand, this mechanical method of energising the studs effectually gets over the main difficulties met with in surface contact systems energised magnetically; in these latter a piece of paper or other bad conductor may break the contact, or the switches may stick and leave a surface contact still "alive;" neither of these faults should occur in the mechanical method.

Just as in the trolley system, there are faults inherently its own; it remains to be seen whether they are sufficiently serious to prevent its coming into general use.

USE OF ELECTRICITY ON WARSHIPS.

A recent issue of the U.S.A. *Army and Navy Register* contained the following interesting reports on the use of electricity as a motive power for all turrets, ammunition hoists and auxiliary machines on board the *Brooklyn*, with Commodore, now Admiral, Schley's commendation of the system. The Bureau of Construction and Repair is greatly gratified over the eminently satisfactory result obtained through the use of electricity as demonstrated in the action off Santiago.

Following are the reports received at the Navy Department:—

North Atlantic Fleet, Second Squadron, U.S. Flagship *Brooklyn*,
Guantanamo Bay, Cuba, *August* 13*th*, 1898.

Sir,—1. I would respectfully report that I am of opinion that the use of electricity as a motive power for all turrets, ammunition hoists, and all auxiliary machines on board ship not in the engine rooms is desirable and would increase efficiency.

2. The use of steam for operating turrets makes necessary great lengths of piping and produces almost insupportable heat in the handling rooms; with electricity this is avoided and greater celerity is accomplished.

3. In the battle of July 3rd, the turrets controlled by electricity did better and quicker work and were not so hot as those functioned by steam.

4. I would, therefore, heartily recommend electricity for these purposes and transmit reports of the commanding and other officers on this point.

Very respectfully,
W. S. Schley,
Commodore U.S. Navy, Commanding Second Squadron, N.A. Fleet.
The Commander-in-Chief, U.S. Naval Force, N.A. Station.

U.S. Flagship *Brooklyn*,
Guantanamo Bay, Cuba, *August* 13*th*, 1898.

Sir,—From the experiences in this ship with electric motors, I am strongly in favour of them for the movement of turrets, ammunition hoists, boat cranes, winches, and all machines where leaky pipes can be dispensed with and quick work required. Incidentally it also is very important to reduce the heat evolved from piping in many parts of the ship, especially in handling rooms. Reliability is the only element which has entered in the discussion of electricity *versus* steam, and in this ship the use of electric motors for the turrets at drill and actual combat has proven them much more reliable. I enclose reports of officers who have had charge of them in this ship. Very respectfully,

F. A. Cook,
Captain, U.S. Navy, Commanding.
The Commander-in-Chief, Second Squadron.

U.S. Flagship *Brooklyn*, First Rate,
Guantanamo Bay, Cuba, *August* 10*th*, 1898.

Sir,—1. In compliance with your verbal instructions of this date, I have to forward herewith, approved, the reports of the three turret officers of the ship on the comparative merits of steam and electricity as a motive power for turrets and ammunition hoists.

2. In addition to the use of electricity for the handling of all turrets and ammunition, I am decidedly of the opinion that it is also advisable to use electricity as a motive power on every auxiliary machine in the ship that is not located within the engine room or fire room.

3. This opinion is based on an experience of over a year and a half on board this vessel, in which the long leads of steam pipes to the different auxiliary machines of the ship have required constant attention and repair on account of leaks and breaks, and have been a constant source of annoyance on account of the heat they give out, and also a decided menace to life in action.

4. Electric wires can be severed without danger, and can be easily and quickly repaired. A burst or cut pipe will fill the whole compartment with steam, will run the pressure down in the boilers, and cannot be repaired without breaking joints and replacing a section of pipe.

Very respectfully, N. E. Mason,
Lieutenant Commander, U.S. Navy,
Executive Officer.
The Commanding Officer, U.S.F.S. *Brooklyn*.

U.S. Flagship *Brooklyn*, First Rate.
Guantanamo Bay, Cuba, *August* 10*th*, 1898.

Sir,—In obedience to your verbal order of this date, I have the honour to make the following report on the relative value and reliability of the electrical equipment of this ship as compared with steam.

1. Electricity is used as a motive power on this ship in the following cases:—Four 5-inch ammunition hoists, two 6-pounder ammunition hoists, eight 8-inch ammunition hoists and for turning the forward and starboard turrets; in all the above cases the power (electricity) has given entire satisfaction, and I firmly believe in its employment on board ship for auxiliary purposes; it has many advantages over steam for such uses on ship board, and the only real points urged in favour of steam are simplicity, less weight and less cost. As to simplicity of steam over electricity, while it may have been true some years ago, it is not so well marked now; for people everywhere are growing familiar with its employment as a motive power. The question of cost, when the attempt is to reach the ideal, should not have much weight, and the difference in favour of steam is becoming less every day. The increase of weight is a matter that requires serious consideration on board ship, and must in every department be kept at a minimum, but the many advantages of electricity demand its employment, and the slight increase of weight due to its use can, I believe, readily be compensated for by cutting the weight of less important material. I have been closely associated with the turrets of this ship, both steam and electric, before and since the commissioning of the ship on December 1st, 1896, and have had the best of opportunities of observing their relative merits. I had charge of one of each kind during the battle with the Spanish fleet off Santiago on July 3rd, the port waist (steam) and the starboard waist turret (electric). The facility with which the starboard turret guns (electric) were laid on the enemy's ships leaves no doubt in my mind that electricity is immeasurably superior to steam as the turning power for turrets, and I also believe this ship would be more efficient than she is now if electricity was adopted for the port and after turrets.

2. All ammunition hoists worked well during the battle, and in every case where there has been difficulties with ammunition hoists

the trouble has been mechanical, and in no way traceable to the power employed.

Very respectfully,

James G. Doyle, Lieutenant, U.S. Navy.

The Commanding Officer, U.S.F.S. *Brooklyn*.

U.S. Flagship *Brooklyn*,

Guantanamo Bay, Cuba, *August 11th*, 1898.

Sir,—1. In obedience to your verbal instructions, I have the honour to submit the following as my opinion as to the comparative merits of steam and electric gear for training the 8-inch gun turrets of this vessel, and the efficiency of its electric ammunition hoists.

2. The absence of any "back kick" when the swinging turret is suddenly brought to a full stop is very noticeable with the electric gear, this being a great point in its favour over steam for quick accurate fire.

3. The speed of train is more surely controlled with the electric gear, thus facilitating training on a moving target, or from a moving platform. With the steam gear, very careful movement of the starting lever is necessary, to prevent the turret from running away.

4. The electric controller enables the gun pointer to stop the turret absolutely, without feeling for the mid-position of the lever of the steam gear.

5. With the electric gear there is no danger of the controlling lever being jarred either way by the shock of discharge of the guns causing the turret to swing unexpectedly, as there is with the steam gear.

6. The electric gear is always ready for immediate use, the movement of a switch being all that is required to place it in action; whereas the engines of the steam gear, like all other engines, should be worked slowly at first, water drained, &c.

7. The heat caused in the handling room and quarters by the engine and piping of the steam gear is a great drawback which is entirely overcome by the use of electricity.

8. A cut wire can be quickly repaired, while the cutting of a steam pipe in action would be a more serious matter.

9. During three engagements with land batteries, one fleet action, and one bombardment, the forward electric turret of this vessel has been under my charge, and has never developed the slightest sign of weakness, nor given me the slightest anxiety concerning its efficiency.

10. For the above-mentioned reasons, electric gear is, in my opinion, far superior to steam gear for the working of the turrets of this vessel.

11. The electric ammunition hoists, both for the 8-inch and 5-inch guns of my division, have always given perfect satisfaction.

Very respectfully,

E. Simpson,

Lieutenant U.S. Navy, in charge First Division.

The Commanding Officer, U.S. flagship *Brooklyn*.

U.S.F.S. *Brooklyn*, First Rate,

Guantanamo Bay, Cuba, *August 11th*, 1898.

Sir,—1. In obedience to your orders requiring a report upon the relative efficiency of steam and electrically-controlled turrets, viewed in the light of the experience of July 3rd in the naval fight with the Spanish fleet, I respectfully submit as follows:—

2. A board, of which I was senior member, appointed by your order of September 29th, 1897, upon the same subject reported then, "in suggesting modification in form, or installation of turret guns or fittings, the board begs to reiterate its unqualified approval of electricity as the power for training turrets. To anyone who has trained turret guns upon a target by electricity, and who has afterward attempted to do it by any other means, the contrast is too striking ever to be forgotten. The electric motor and controller give perfect control and fineness of train to an ideal degree."

3. Now, after experience in handling turrets under fire, in a running fight of four hours, I fully endorse the report of the board given above. I would like to add in favour of electric turrets that the temperature of the closed handling room of the steam turrets was terrible in comparison. There was also the danger of death to everybody in the handling room from shell cutting a steam lead.

Very respectfully,

Wm. R. Rush,

Lieutenant, U.S.N., commanding Second Division.

The Commanding Officer.

SIR W. H. WHITE ON ENGINEERING EDUCATION.

Occupying the position of naval constructor to Great Britain, we all naturally feel that any remarks falling from Sir W. H. White ought to be worth listening to. In this country we are so much dependent upon the Navy, and the fact is so very patent to us in the present crisis, that we all wish to feel that so important a matter as our Navy is in such competent hands to design.

His address to the Institution of Junior Engineers is thus invested with an importance it would not have in the hands of a less prominent man. The gist of his observations were against narrowness. He pointed out that advance along practical lines had been very largely due to the scientific research of men who were outside the subject on which their researches had had such far-reaching effect. Thus Fairbairn and Brunel were only amateurs in shipbuilding, yet the treatment of a ship as a girder was due to them, while to Rankine and Froude—both outsiders—is due the whole modern theory of naval architecture. Sir William acknowledged freely the debt due by shipbuilding to the outside engineer, and he laid stress on the necessity of foresight in designing harbour works. For an example he took the Birkenhead Docks, which are still in the front rank, as capable of receiving the largest ships afloat. Yet when constructed, they must have seemed very excessive in their dimensions, but events have justified the anticipations of the designers.

Regarding training, Sir William expressed himself strongly on the necessity of a boy going into the practical part of the work direct from school. It is then that roughing it comes easiest. Indeed, is it not a fact that most English boys, at least, look on the roughing part as so much fun. It is there that they best get on with workmen, and the powers of observation are quick. The technical college should follow the practical course, and the student then can benefit by a scientific training, which his practical course has probably shown him to be necessary if he wishes to rise above the ranks.

Coming from such a source, the remarks of Sir William White are deserving of credence. There is sound sense in them. The average student becomes unfitted by a college or school course for genuine rough work, and some rough work ought to come before the more theoretical training. A sharp youth will, moreover, be better able to appreciate wherein he is shortcoming.

Sir William withholds his opinion on the question of premium apprentices, but expresses the hope that this class will combine theoretical training with their period of employment. So far as we have seen the premium apprentice, he has appeared simply as an idle loafer. That there are exceptions, and brilliant ones, we admit, but as a class we do not think much of them.

SUBMARINE CABLE VESSELS.

The following is a complete list of vessels employed in connection with submarine telegraph work. It will be observed that there are altogether 41 such vessels, with a gross tonnage of 64,615 tons, and 8,971 nominal H.P.

Owners.	Name of ship.	Gross registered tonnage.	Where stationed.
Amazon Telegraph Company ..	Viking	436	Para
Anglo-American Telegraph Co.	Minia	1,386	Halifax, N.S.
Canada, Government	Newfield	785	„
Central and South American Telegraph Company.	Relay	1,198	Callao
China, Government	Fee-Cheu	1,034	
Commercial Cable Company ..	Mackay-Bennett	1,731	Halifax, N.S.
Cie. Française des Cables Télégraphiques.	Pouyer-Quertier	1,385	Havre
Do. do. do.	Contre Amiral Caubet*	2,207	„
Eastern Telegraph Company ..	Amber	1,043	Gibraltar
„ „ „ ..	Electra	1,219	Suez
„ „ „ ..	John Pender	1,213	Zanzibar
„ „ „ ..	Mirror	1,545	London
„ „ „ ..	Chiltern	1,391	Malta
Eastern and South African Telegraph Company.	Great Northern	1,422	Cape Town
Do. do. do.	Duplex	874	„
Eastern Extension Australasia and China Telegraph Co.	Recorder	1,201	Singapore
Do. do. do.	Sherard-Osborn	1,439	„
France, Government	Ampère	304	Brest
„ „	Charente	547	La Seyne
Great Britain, Government ..	Monarch	1,122	Woolwich
„ „ „ ..	Alert†	369	Dover
Great Northern Telegraph Co.	H. C. Oersted	749	Copenhagen
„ „ „ „	Store Nordiske	832	Shanghai
I.R., G.P., and Telegraph Works Company.	Buccaneer	785	London
Do. do. do.	Dacia	1,856	„
Do. do. do.	International	1,381	„
Do. do. do.	Silvertown	4,935	„
India, Government	Patrick Stewart	1,115	Kurrachee
Japan, Government	Okinawa Maru	2,278	Nagasaki
New Zealand, Government ..	Tutanekai	811	Wellington, N.Z.
Italy, Government	Citta di Milano	1,247	Spezzia
Siemens Bros. & Co.	Faraday	4,917	London
Société Industrielle des Téléphones.	François Arago‡	3,191	Calais
Telegraph Construction and Maintenance Company.	Britannia	1,525	London
Do. do. do.	Calabria	3,321	„
Do. do. do.	Scotia	4,667	„
Do. do. do.	Seine	3,553	„
West Coast of America Telegraph Company.	Retriever	634	Callao
Western Brazilian Telegraph Company.	Norseman	1,117	Bahia
West India and Panama Telegraph Company.	Duchess of Marlborough	402	St. Thomas, W.I.
Do. do. do.	Grappler	868	„ „ „

* Late *Portena*. † Late *Lady Carmichael*. ‡ Late *Westmeath*.

The *Citta di Milano* is given in Lloyd's Register, 1898—99, as belonging to the Italian Government. The *Calabria* has,

we believe, been recently sold, but her name still appears in Lloyd's Register, 1898—99, as a cable ship and belonging to the Telegraph Construction and Maintenance Company.

TELEGRAPHS AND TELEPHONES IN PERSIA.*

The first telegraph line in Persia was established about 36 years ago, and in the beginning was vigorously denounced and opposed by the priests as being a species of magic, and closely allied to other evil principles greatly subversive of religion and the best interests of the State, and as such not to be permitted to have a place in the economy of government. This opposition, however, was overcome, and the class which resisted so stoutly at the first now use the telegraph with the greatest indifference. In the year 1862 the construction of a telegraph line from India to England through Persia, Russia, and Germany was commenced, and it began working on January 1st, 1870. Some work had, however, been carried on for three or four years by a line through the Euphrates Valley; but according to the United States Vice-Consul at Teheran, this was not by any means of a satisfactory character, and serious errors, delays, and interruptions occurred. This line is still used occasionally. The Indo-European is a well-constructed and efficiently managed line. From Bushire to Karachi there is both a cable and a landline. This line provides the local native administration with one wire which can always be depended upon. The local lines, with the exception of the one wire mentioned above, are the property of the Persian Government. The ownership was acquired by the cost of construction, and has been maintained by defraying the expenses of preservation. The actual administration is deputed to one man, who, until very recently, contributed to the Government £2,400 a year. This royalty has now been raised to £6,000 a year. The yearly receipts of the telegraphs have been about £12,000, and the expenditure equals, if not exceeds, the income. In consequence, certain reforms are to be initiated in the direction of compulsory payments. It is stated that fully 50 per cent. of the telegrams are sent free. Officials of the Government (central and local), priests, expounders of the law, relatives of persons connected with the working and the administration, and everyone who can provide himself with a reason or excuse, send their telegrams free of expense. As this system has been growing for many years past, and most of those who have been benefited by it are in a position to give trouble, the management find it difficult to introduce changes necessary for their own protection. The Persian local system comprises about 3,100 miles of wire and 86 offices for the receipt and despatch of messages. The wire provided by the Indo-European administrations, gratis, is about 1,300 miles long, and extends from the Persian Gulf to the Russian frontier. Stamps are not used for any purposes in Persia, except for letters. Messages are restricted to 10 words, at a charge of 2½ krans (about 9d.). The actual charge for the message is 2 krans, and the half kran is for the paper on which it is written. In case the message extends to a large number of words it is calculated at the rate of 10 words to the 2 krans, and not 2½ krans. This tariff is the same for any distance in Persia; there is only one charge. The Persian newspapers rarely contain information of sufficient importance to be sent by telegraph, consequently there is no press rate, and, indeed, there are very few press messages. There are four newspapers in Persia, printed in the vernacular, and under Government control. These should be issued once a fortnight, but they are often issued at longer intervals; they are in no sense considered as leaders or exponents of the ideas or feelings of the people. As regards telephones the late Nasredin Shah on December 8th, 1889, granted to the then Minister for Foreign Affairs a concession for electric lighting, the introduction of telephones, phonographs, and the application of electricity to industrial purposes to the whole of Persia, with protection to the monopoly for the period of 60 years. This concession was transferred to an American citizen for a certain valuable consideration, but for want of means the purposes of the concession have not been put into execution. In order to protect the concession from lapsing, two or three wires were put up and kept in a workable state, and are now in use. Five years ago the railway and tramway company commenced erecting private wires for anyone who would undertake the expense, and they established an exchange office on their own premises at Teheran. It has not been extended to any other town. So far, no records have been kept of the number of miles of wire erected, but the Vice-Consul says that from his observation he should estimate it at about 50 miles—this is including the wires into villages of summer resort, and those to different parts of the city. At the present time there are 15 owners of private wires, each of whom pays the company about 8s. 6d. per month for keeping the wires in repair, and the instruments in order. The receipts about balance the expenditure, but this only includes the free use of the lines by the company, who provide the only office there is in the city, and two in the country during the summer months. As messages are not received from the public, no tariff has been formulated. Subscribers are put into communication, and use the telephones as long as they wish. As a more extended use of the telephone would interfere with the receipts of the telegraphs, permission to use it has not been granted to distances appropriated by the telegraphs.

* *Society of Ar Journal.*

LONDON COUNTY COUNCIL.

At the usual meeting on Tuesday it was resolved to lend £10,470 to the Shoreditch Vestry for works in connection with the electric light station.

Loans and Deferred Repayment.

The report of the Finance Committee disclosed a curious point in regard to the application of the Newington Vestry for a loan of £50,000 for electric lighting purposes, £10,000 of which was asked to be advanced at once. With respect to the method of repayment, the Vestry asked that the instalments to be repaid for the first five years might be deferred and spread over the remaining 37 years, the reason given for this proposal being that the Vestry desire to make the undertaking self-supporting from the commencement, to accomplish which they state that it will be necessary for the repayment of capital to be deferred until sufficient consumers have been secured to effect this object. The Vestry propose to take up the £50,000 applied for in instalments of £10 000 as required, and to postpone the repayment for five years, in each case, from the date of the advance.

This is the first case in which the Council has been asked to sanction the postponement of repayment, and, after careful consideration, the Finance Committee expressed the opinion that such a postponement might in certain cases be allowed. The Committee were, however, not prepared to recommend that the repayments should be deferred for so long a period as five years in this instance, and they proposed that the repayment of principal should be postponed for three years. The Vestry having agreed to this course, the Committee recommended, and the Council decided, to advance the first instalment of £10,000 at 3 per cent. on deferred repayment for three years.

New Generating Station.

It was decided to approve of a deviation from the plan deposited with the application of Mr. A. Roberts, on behalf of the Chelsea Electricity Supply Company, for the erection of a generating station in Flood Street, Chelsea, as shown upon two plans submitted, with a further application by the architect.

Electric Traction.

In the course of a lengthy report on house accommodation, the Housing of the Working Classes Committee quoted from reports prepared on the subject by some of the Council's officers. One of these was from the valuer, who, among other matters, stated that "there is another factor in the question, viz., the want of cheap and rapid transit between these central locations where so many of the inhabitants are employed and the outlying districts in which they should live. New York, which is, of course, confronted with problems similar to these, has, I believe, found in its tramways and overhead railways some assistance in the solution of the problem, though no doubt much remains to be done. The Council will probably in a few years be the owners of all the tramways in the county, and will be able to construct or introduce improved services and methods of traction, one of its objects being that which the Housing Committee have in view. The Committee have already compiled a mass of valuable statistics with reference to workmen's trains; and there is no doubt that, although the railway companies (with the exception of the Great Eastern Railway) contend that the extension of workmen's trains desired by the Council would not pay, the establishment of serious competition with their suburban traffic by means of electric tramways would be the best means of inducing them to reconsider their position."

The Housing Committee, in connection with this matter, stated that London is far behind the chief cities of Europe in the application of electricity on tramways, and that in their opinion this state of affairs should be remedied without delay.

CORRESPONDENCE.

A New Property of Iron.

Noticing your reprint of the letter to *Nature*, by Mr. J. S. Stone, I write to mention that I had my attention drawn to the phenomenon described in the following way:—Wishing to solder part of an apparatus of some depth (it being in cylindrical form) I made an exceptionally long iron handle, of quarter inch round iron, fixing it to a copper bit, on cooling the bit in a tub of water, I was compelled to release the handle, owing to the rush of heat, this was some three years ago. I concluded that the cause was due to the greater resistance offered by the water to the escape of the heat, thus causing it to flow through the readiest channel, viz., the handle. It is remarkable that the same thing does not occur with a brass rod, as I have demonstrated since reading your letter, and which fact opens up a new area for investigation.

P. D. Brant.

Boiler Feed Pumps.

In your issue of July 1st last there appeared a paper on "Steam Using Plant," by Mr. J. A. Jeckell, borough electrical engineer, South Shields, in which, while discussing the pumping plant at the station under his direction, he took occasion to speak somewhat disparagingly of pumps and pump makers generally.

In your issue of September 16th, Mr. H. Faraday Proctor, city electrical engineer, Bristol, published a further series of pump trials; while more recently, in your issue of the 14th ult., we have been favoured with the views of Mr. J. Alexander McLaren on the same question, all of which, when coupled to your editorial comments on the first paper, must lead us to the conviction that electrical engineers have got into a very indifferent market for their auxiliary machinery, and that they do not hold a very close communion with the marine engineers of the country. It is many years since marine engineers discovered the ultimate cost of a cheaply made, unreliable, and inefficient feed pump; they of all engineers cannot afford inefficiency, breakdowns at sea, delays in foreign ports, and eternal repairs when at home, hence the demand for an economical and reliable pump arose.

The supply was immediately forthcoming, with the result that at the present time complaints are seldom heard of.

The title of Mr. Jeckell's paper is a most appropriate one when read in connection with the latter part of it, wherein he relates his experience of four pumps, the first of which delivers 31·3 lbs. of water per pound of steam used, against a head of 22 feet with 18 feet lift. No. 2 pump delivers 18·3 lbs. of water per pound of steam used under similar conditions. No. 3 pump delivers 1·777 lb. of water per pound of steam used when feeding boilers at 160 lbs. working pressure; while No. 4 pump delivers ·957 lb. of water per pound of steam used, working under the same conditions as No. 3. In other words, the boiler which No. 3 pump supplied with feed water was able only to keep the pump in steam, doing nothing else, while No. 4 pump served the phenomenal purpose of taking more out of the boiler than it put in. Manifestly, the description of such machinery is "steam using plant."

With regard to Mr. Proctor's pump trials, the steam consumption is given in pounds per B.H.P., a system of analysis which is not altogether satisfactory, because of possible discrepancies which may arise between one experimenter and another; moreover, in the case of a pump, time need not enter into the question at all. When the head of discharge is the same, as in testing the relative merits of two pumps performing the same duty, a comparison is easily drawn in terms of pounds of water delivered per pound of steam used; but in general it is preferred to give the performance in foot-pounds of work done per unit of heat expended. However, from the data given, I will endeavour to institute a fair comparison, and answer all three writers at one time:—

1. With regard to the type of pump, it would appear that reliability of action with few repairs is of the utmost importance in an electric light station, as it is on board ship, and while all three writers are agreed upon this point they are strangely at variance as to the means of attaining it. Surely a direct acting slow running pump will excel all others in this respect, because it has the fewest working parts, and if properly made will have the least amount of wear and tear. Other things being equal then, we cannot be far wrong in selecting this type of pump, because, having the qualities above mentioned, it will require little attention, and those three combined go a long way towards the general economy of a pump.

2. The efficiency of the pump *per se* is an important factor affecting the end in view. In order to avoid any misunderstanding or confusion of terms it may be as well to state clearly what is meant by "pump efficiency." If we take twice the area of the pump piston minus the area of the rod, then multiply by the stroke, all in the same units of measurement, we will have the net volume or piston displacement per revolution; then the relation which the actual volume delivered bears to the piston displacement is the pump efficiency. When the pump efficiency is low the steam consumption must be correspondingly high, the wear and tear being likewise augmented to the same extent. In this connection Mr. Jeckell doubts whether there is a pump made which will give a higher efficiency than 75 per cent. I am in a position to assure him that there are thousands of pumps working with a higher efficiency than that named, that there are pumps of the direct acting slow running type being manufactured *in this country* every day, having an efficiency of not less than 95 per cent., and I have tested more than one which gave an efficiency of 99 per cent. at pressures ranging from 30 lbs. per square inch to 500 lbs. per square inch. In each case the actual volume of pump displacement was measured, the water was measured in tanks and checked by direct weight, the total number of revolutions being recorded by a counter on the pump.

3. On the question of steam consumption I think Mr. McLaren might have been gracious enough to leave some room for doubt, because, although there may be differences upon matters of opinion, there can be none, I presume, upon matters of fact, and having recently made some steam consumption trials with the type of pump which he so confidently denounces, viz., the slow running direct acting pump, I think he will have some difficulty in finding a steam driven fast running fly-wheel pump for boiler feeding on the market to beat it or even approach it.

The following is a condensed summary of two trials with a Weir boiler feed pump, having its steam cylinder 8 inches diameter, pump 6 inches diameter, stroke 15 inches, double acting:—

Steam pressure at pump	110 lbs.	107 lbs.
Water pressure at pump	164 „	164 „
Revolutions per minute	15·9	6·0
Efficiency of pump	97·25 %	96·6 %
Lbs. water delivered per lb. steam ...	84·6	55·3
Lbs. of steam per net W.H.P.... ...	63·1	95·3
Ft. lbs. of work per B.T.U. to 212° ...	31·1	21·0

Over 12 trials were made with this pump at various speeds, and in no case did the pump efficiency fall below 95 per cent., even at three revolutions per minute.

Those results compare favourably with Mr. Jeckell's feed pumps, which on an average delivered 1 lb. of water per pound of steam, as against 84·6 lbs. of water per pound of steam at the same pressure.

It will also be observed that at its normal speed of 16 revolutions per minute this pump uses 35 per cent. less steam than the *compound* duplex pump cited by Mr. Proctor, and although not so economical in this respect, when exhausting into the atmosphere, as his motor pump with full load, it is more economical at lower speeds, because no bye-pass is required; moreover, the exhaust from a steam-driven pump is available for other purposes, and if utilised either for expansion in the L.P. cylinder of a main engine or for feed heating, its ultimate economy may be made to excel the motor pump at any speed. But what is of far more importance, the direct acting pump is free of all complicated gearing, its simplicity promotes economy in other respects which far outweigh the difference in steam consumption without utilising the exhaust.

A similar type of low pressure pump which I tested recently, having a steam cylinder 6½ inches diameter, pump 7 inches diameter and 14-inch stroke, delivered 248 lbs. of water per pound of steam against a pressure of 30 lbs. per square inch, and with steam of 70 lbs. pressure, when exhausting at atmospheric pressure, the revolutions being 45·6 per minute and the pump efficiency 99 per cent. This, too, compares rather favourably with Mr. Jeckell's experience of 31 and 18 lbs. of water per pound of steam at about the same pressure.

To summarise the question, it may be said that motor pumps must run too fast, have too many parts to go out of order, require too much attention, and lose too much water at low powers to be either reliable or generally economical.

Fly-wheel pumps have to some extent the same objections, with the addition of large steam clearance spaces, and may be running half full of water without giving any indication of it.

Duplex pumps are in reality composed of two direct-acting pumps, each of which depends upon the other for its action, consequently there are two chances to break down for one in the single pump. The steam clearances are very large on account of its eight necessary steam ports as compared with two in a single cylinder pump, and even this excessive clearance is generally aggravated by a shortening of the stroke.

Taken all in all, the direct acting single pump carries the balance of advantages for feeding boilers. Its principal defect is one common to all pumps of this class, namely, that

it is often badly made, but if care be taken in selecting good design, material, and workmanship, it has no rival.

Although my subject is not exhausted, I am afraid I have already encroached too far upon your valuable space, but the interest evinced on the question is my excuse, and if I have shown that there are already pumps on the market which will meet all the requirements of an electric light station as they have done at sea, the object of my communication will have been attained.

J. Andrews.

Cathcart, N.B,
October 29th, 1898.

Soft v. Hard Rubbers in Making Copper Tubes.

It was your late contributor, Alexander Watt, who first discovered that it is a mistake to use a hard burnisher or rubber for making tubes by depositing copper on revolving mandrels.

The following extract of his complete specification, No. 9,652, 1891, filed by Mrs. Eliza Watt, his administratrix, does not leave any doubt on this point and settles it:—

"It is not intended in this specification to claim the use of a burnishing tool of agate or glass or other hard substance acting under considerable pressure on the copper deposit in the bath, while the deposition is taking place, as the effect of such a tool is to foliate or stratify the deposit; a result which it is the sole object of the present invention to overcome, but what is claimed is, in the manufacture of copper tubes by electrolysis, the use of friction produced by the application of yielding surfaces such as brushes and pads. The brushes may be made from strong bristles, cocoa-nut fibre, or whalebone. The rubbers may consist of pads of leather, cork, felt, or India-rubber, which friction surfaces will, by the aid of moderate pressure, produce the desired result."

F. A.

The Position of Draughtsmen.

For sheer conceit your correspondent "Truth," in last Friday's issue, about takes the palm. It is, I venture to think, a well-known fact that the premium pupil *is* ousting, not only draughtsmen, but many other classes of engineers, and is quite content to work for about as much money as would keep an ordinary individual in tobacco. After serving three years with a firm of engineers, during which time the firm takes his £100 a year and looks on him as a "necessary evil very disturbing to their peace of mind," the dear boy generally takes office as assistant *(sic)* engineer, and is so pleased with the honour and glory of the position that the question of salary troubles him not at all.

From the tone of your correspondent's letter one would think that what this gentleman of *three whole years'* experience didn't know wasn't worth knowing, and it is manifestly quite absurd to expect a poor draughtsman to provide him with any information *outside* the drawing office, the marvel to me being that he could provide him with any *inside* the office which this hopeful didn't know before. I speak feelingly, as the junior draughtsman in our office has just been given his *congé* in order to make room for a 'prentice with about as much knowledge of drawing as a toothpick. "Truth" ends his letter by advising your correspondent (who is probably a gentleman old enough to be his father), to become a "cab driver under police supervision."

The best chance for Mr. "Truth" is to leave the ranks of the electrical profession and attach himself to a South American cow ranche, where he will have more work and less time to air his opinions, and take up space in your valuable journal.

A.I.E.E.

Wire and Cable Testing.

Would any of your readers be kind enough to explain the following phenomena:—

Several times recently whilst testing cable and gutta-percha wire by means of the ohmmeter and generator method, I have observed the following results: The needle has at first shown a very bad insulation, say, from 1 to 5 megohms, and has remained constant at this for about a minute, and then it will gradually come up to 10 megohms or infinity, and show the wire as having a perfect insulation. No amount of further testing will break down the insulation, although, if the wire is left in the tank another day the fault again appears and disappears in the same manner. The instruments have been proved all right.

Perhaps some of your readers can throw some light on the matter.

Chas. F. Ashton-Pryke.

English v. Foreign Meters.

We ask for permission to call attention through your columns to a disadvantage under which we, as English inventors and manufacturers in England of electricity meters, suffer in having to compete with foreign meters made abroad, with all the advantages of long hours and low wages.

Notwithstanding the fact that Parliament has decided that in all Government contracts there shall be a clause that where practicable all goods supplied under them shall be of British manufacture, and that this clause has been adopted by a majority of municipal corporations, yet there still remains a number of municipal contracts under which foreign made meters are not excluded, though the English manufacturer is additionally handicapped by the requirement that for all his goods the trades union hours and wages shall be followed, thus leaving, so far as price and profit are concerned, a still greater advantage in the hands of the foreigner. We think it is only necessary to call attention to the matter, for municipal authorities and consulting engineers to bring their tender forms into line with those of the Government, for it is a recognised principle, at least as regards goods paid for with public money, that the competition of cheap foreign labour should not be encouraged.

It must be understood that we do not at all object to the competition in meters of foreign inventors, we only ask that their inventions, if sold in England, should be made in England, and should contribute, as ours do, to the support and encouragement of native industry and to the relief of our municipal rates and Imperial taxes.

For Chamberlain & Hookham, Ltd.,
Arthur Chamberlain, *Director.*

Electric Traction Without Overhead Wires.

Your article upon the Thompson-Walker surface contact tramway deals with (*a*) opinions, &c., (*b*) facts. Leaving those in your opinions to take care of themselves, I propose to correct some errors in your statements of fact.

You condemn the collecting skate as a "flimsy-looking device" which will bind on the studs because of its rigidity, and you say it ought to have been mounted on springs, or, as you put it, "springiness will be found necessary somewhere." As I designed the skate perhaps you will permit me to say that the "flimsy-looking" skate is composed of a channel steel girder, $4\frac{1}{8}$ inches wide, with $2\frac{1}{2}$-inch sides. It is supported on brackets made of $3\frac{1}{2}$-inch × 1 inch wrought-iron. At the ends, for a length of about 2 feet, the sides are cut away so as to give a slight springiness in the metal itself. The whole is mounted on springs and moves freely up and down between stops having sufficient play to cope with any possible variation of levels. These springs carry the greater part of the weight of the skate, which runs lightly on the studs. One of the springs can clearly be seen in your illustration.

You say that it is perfectly possible that some surface contact systems may be practicable and satisfactory, but that this cannot be the case "until a trial under the most difficult circumstances has been made by a disinterested company for a period of at least three years." That is precisely what we are anxious to have—a three years' contract with a disinterested company who will give the system a thorough trial. But does your article help us to get that thorough trial? If you had honestly wished such a trial to be given would you have written five columns without once mentioning—for that is what you have done—the essential principle of this system, which gives it its safety? If you wished the thing to be given a fair trial, why did you start by saying that "in the present state of the art we think it extremely

unlikely that anyone gives consideration to the use of surface contact or closed conduit systems when either the open conduit or the trolley wire are at all possible"? It scarcely looks as though you wished the Thompson-Walker system to have the three years' disinterested trial, without which you say no system will be satisfactory.

Charles E. Holland.

Hampstead, *November 2nd*, 1898.

"Dumoulin Copper Depositing Process."

I am sure you are to be congratulated on having opened your columns to a discussion of the merits of the Dumoulin process. On the one hand Mr. Moir, who is, I understand, the promoter of the Electrical Copper Company, claims immense advantages for it over all other electrolytic processes for the manufacture of copper goods; on the other hand, I have heard the most damaging statements in reference to the *rationalé* of the process made by those who should be in a position to judge of its merits.

The subject of electro-metallurgy is one which, like electro-therapeutics, lays a little off the main road of electrical engineering, and for that reason is more interesting to the average electrical engineer, than the dry every-day practice, but just for the same reason it seems to me that to a great extent it has become the happy hunting ground for the empiric and the impostor, very many thousands of pounds have been lost to both classes by the investing public, and it is well, therefore, in the interests of electrical engineering that you should have opened your columns to a discussion as to the merits of the last newcomer.

Is the Dumoulin process a *bonâ fide* invention or not is the question which first of all requires answering? If it is a genuine invention, what merits has it over the older process of Elmore? To answer the first question it is necessary to ascertain what the Dumoulin patent consists of; the first patent clearly states that its object is to prevent the roughness of electro deposits made on rotary cathodes by touching the projections with a greased impregnator which insulates the projection until the surrounding metal has grown up to its level, when the film of grease automatically returns to the impregnator, and the deposit proceeds without the nodular growths which we are all familiar with. Every amateur, I think, knows that if during deposition the smallest amount of grease touches the surface all the metal deposited over that spot is non-adherent and blisters when annealed, and I must confess that I have never seen any explanation as to how this difficulty is overcome in the Dumoulin process. I await with interest some explanation on the point, and until it is cleared up, the material produced by the process must rest under a grave suspicion with everyone having even a superficial knowledge of the subject.

The second point as to the advantages which can be shown over the Elmore process, Mr. Kershaw does not touch upon, and it is to be hoped that these will be formulated by Mr. Moir, or the able works manager of the Electrical Copper Company, Mr. Langdon, so that we may know clearly wherein the Dumoulin process is superior.

F. G.

I have read Mr. Kershaw's article under the above heading, and also the letters in your last issue bearing on the matter, but it is pretty clear that these have all been written in the interests of the Elmore Companies, and I will, with your permission, say a word on the other side, though I have no interest whatever in either patent.

The suggestion, I presume, contained in the letter signed "F" is that these Dumoulin patents are worthless; surely "F" cannot be aware that Mr. F. Moulton reported as to the validity, and the late Dr. Hopkinson as to the commercial value of the process, which, next to the successful action for infringement, is the very best evidence of the soundness of the property. No doubt £400,000 seems a lot of money to pay for a patent, but if that patent constitutes a monopoly in such a gigantic trade as the manufacture of all copper goods, surely the money will come back in the form of royalties many times over. To really comprehend the scope and remarkable features of the Dumoulin patents it is necessary to go more into detail than Mr. Kershaw did in his very brightly written description of the works of the Electrical Copper Company, and I recommend any of your readers interested in the matter to obtain a copy of a pamphlet issued by the Electrical Copper Company, entitled "The Electric Fining of Copper," by E. Dumoulin, which deals very fully with the statistics of the electrolytic copper business, and indicates clearly the points of difference between the Dumoulin and Elmore processes. Electrical engineers should hail any new process which is to extend the field of electrical work rather than cavil at it. No doubt it must be very annoying to Mr. Elmore to think that his very interesting process is to be superseded by something more up-to-date, and backed by such an influential group, but I am sure that his chagrin will not be shared by the majority of electrical engineers.

J. M.

Explanation.

As the report, noticed in your last issue, that we intend to acquire the Totnes town mills, may lead to some misconception as to our position in the matter, we should esteem it a favour if you would kindly make it clear that we are only acting as the consulting engineers, and are acquiring the mills on behalf of clients of ours.

Handcock & Dykes.

OBITUARY.

Latimer Clark, F.R.S., M.Inst.C.E.

With the sudden death of Mr. Latimer Clark on Sunday last, the ranks of pioneer land and submarine telegraphy have become reduced to a very fine point, though we still have with us Lord Kelvin, Sir Samuel Canning, Mr. Edward Bright, Mr. F. C. Webb, and Mr. Henry Clifford.

Born in 1822, Mr. Clark had reached his 77th year; and, from the telegraph engineer's standpoint, his life has plenty to show for it.

From early youth, young Clark showed a strong taste for chemistry, and it was not long before he was employed in a chemical industry. Subsequently, through his elder brother, the late Mr. Edwin Clark, he became associated with railway surveying, being appointed assistant engineer to the former, and Mr. Robert Stephenson, on the construction of the Menai Straits Britannia Tubular Bridge a little later. But, like his brother, Latimer Clark was ultimately destined for a telegraphic career. Thus, a few years after its formation in 1847, he became assistant engineer to the Electric Telegraph Company, Mr. Edwin Clark being his chief. A little later, on his brother's retirement, young Latimer was appointed engineer to the company. His introduction to telegraph work was through having attracted some attention, whilst at Menai, by employing electricity to fire a time-gun.

Young Clark's inventive talents soon made themselves apparent. They were first testified to in his insulator, and a little later by the pneumatic system of transmitting telegraph messages, afterwards developed by Mr. C. F. Varley.

At first the "Electric" Company confined their attention to constructing and working land telegraphs. Latimer Clark was, however, also acting in a technical position to the International Telegraph Company, and was thus associated with the laying of some of the earliest submarine cables from this country to Holland, Belgium, &c., between 1853 and 1855. About the latter date, the "International" Company was absorbed by the "Electric," under the style of the "Electric and International Telegraph Company," with Latimer Clark as engineer-in-chief.* A little later, on his professional practice promising to become more extensive, he confined himself to acting in a consulting capacity to the company. Clark was one of the first to draw attention to the retardation of electricity through a covered wire by induction, and to

* For further particulars regarding these early telegraph days, we would refer our readers to the series of articles on the "Telegraphs of the United Kingdom," which appeared in the Electrical Review of September 10th and 24th, 1897.

insist that a high potential (or tension, as it was then termed) was of no advantage for transmitting signals through a cable. Indeed, it was connected with this demonstration—so clearly expressed later in his "Electrical Measurements"—that he first came prominently to the fore. Mr. Latimer Clark served on the Committee appointed at the instigation of the Board of Trade, in 1860, to inquire into the entire question of the construction of submarine telegraphs, and it is no exaggeration to say that his report on the subject last alluded to (embodied in Appendix 2 of the Blue-book) was probably the most valuable piece of evidence drawn forth.

In 1861 Mr. Clark became associated professionally with Sir Charles Bright, and the partnership proved a useful one, for the firm of Bright & Clark acted as engineers in connection with the construction and submersion of most of our early telegraph cables. In the first year of the above partnership, Mr. Clark joined with Sir C. Bright in a paper read before the British Association on "Electrical Standards and Units," in which a definite and practical system of electrical measurement was for the first time suggested, and was at once adopted.

As engineers to the first Persian Gulf cable to India in 1863, Messrs. Bright and Clark conducted a series of experiments—now classic—on the effect of temperature on the electrical resistance of gutta-percha. From these, the formula for correcting the resistance to a standard temperature was arrived at; this is now in every-day use. Though the bituminous composition patented in 1858 in the names of Clark, Braithwaite and Preece (known as "Clark's compound") did not prove a success—and had to be abandoned after a single trial, mainly on account of the method of application—the Bright and Clark system,* first used on this same Indian Government cable, has been universally employed for preserving the iron sheathing wires ever since. Messrs. Bright and Clark acted as engineers to the Anglo-American Telegraph Company for the purposes of the second and third Atlantic lines. After the two cables (of 1865 and 1866) had been successfully laid, Mr. Clark, on behalf of his firm, tested and worked through the entire length.

In 1868 the partnership of Bright and Clark came to an end, and a little later Mr. Clark joined with Mr. H. C. Forde (who died but a short while back) and Mr. H. A. Taylor as senior partner in the firm of Clark, Forde & Taylor—a firm which has been honourably connected with some 60,000 miles of submarine cable in various parts of the world. Of late years it has become rather the fashion with those commercially interested in submarine telegraphy to do without engineers. Whether or no this fashion is well-advised is an open question.

Clark's standard cell is, no doubt, what the name of Latimer Clark will be most closely associated with in the history of electrical science. Its use in the laboratory as well as in general testing is almost unbounded, especially in the present form arranged by Dr. Muirhead. Unfortunately, space will not permit us to dilate at length on Mr. Clark's various inventions and methods of testing. These latter include his plan of testing joints by "accumulation"—the only method of any value—and his famous test for localising a fault in a cable by the fall of potential.

In 1871, the well-known "Electrical Tables and Formulæ," jointly compiled by the subject of this obituary and Mr. Robert Sabine saw the light of day; this was partly a revision of Clark's "Elementary Treatise on Electrical Measurements" (first published in 1868), already alluded to.

Besides his consulting engineering work, Mr. Clark was also senior partner in the late firm of Latimer Clark, Muirhead & Co., manufacturers of electrical apparatus and machinery. He was also partner in the firm of Clark and Stanfield, mainly in connection with floating dock construction.

In later years Latimer Clark interested himself greatly in electric lighting, in both a technical and business capacity. Thus, from its initiation up to the time of his death, he was an active director of the St. James's and Pall Mall Electric Lighting Company—perhaps the first entirely successful concern of its kind.

Mr. Clark had always followed science closely in all directions. He has written more than one astronomical work, and formerly owned an observatory. The wonder is that he was not elected an F.R.S. till within a few years of his death.

The subject of this memoir was one of the founders of the Society of Telegraph Engineers (now the Institution of Electrical Engineers), and became its president in 1875.

The name of Latimer Clark will always be prominently associated with early land and submarine telegraphy. His death is to be deplored by his professional brethren, but we are glad to learn that the end was entirely free from pain. He was active up to the very last, though less heard of in the outside world within recent years.

* See Sir C. Bright's specifications, Nos. 466 and 538 of 1862.

LEGAL.

Everard v. Higgs.

On Friday in the Queen's Bench Division before Mr. Justice Wright and a jury, the case was heard of Everard v. Higgs. This was an action brought by Mr. Frederick Edward Everard, an electrical engineer, against Mr. John Limbrey Higgs, a solicitor, to recover £60, in respect of certain shares, which the plaintiff said he had transferred to a third party at the defendant's request. It appeared that the defendant purchased a patent for an electrical accumulator and formed a company entitled the I.E.S. Accumulator Company to work the patent. The plaintiff had 100 shares in the company, and in March, 1896, the plaintiff said the defendant came to him and informed him that he had arranged to sell 10,000 or 20,000 shares, and that he had not that number in his possession. He asked the plaintiff to transfer his 100 shares and promised to pay him the amount realised by their sale when he received the money. The plaintiff transferred his shares, and subsequently heard that there had been a pooling arrangement. He asked the defendant for the money which the shares had realised, and the defendant alleged that the plaintiff was a member of the pool and would have to take his share of the pooling arrangement, which would entitle him to 66 vendor's shares, 17 out of 5,000 new shares purchased out of the proceeds of the pool, and £1 13s. 4d. in cash. Eventually the plaintiff agreed to accept this, but the defendant failed to take any steps to transfer the shares until after proceedings for the winding-up of the company had been instituted. He now submitted that he was entitled to stand by his original arrangement with the defendant, that he should receive the price realised by the sale of the shares, which was 12s. each. The defence was one of accord and satisfaction. It was said by the defendant that he offered, and that the plaintiff agreed to accept, the vendor's shares and the new shares in satisfaction of his claim. These shares had been tendered but had not been accepted by the plaintiff. Mr. G. M. Scott was counsel for the plaintiff, while Mr. Bentley Dennis represented the defendant. In the result the jury found a verdict for the plaintiff, assessing the amount to which he was entitled at £50. Judgment for plaintiff accordingly with costs. On the application of the defendant's counsel his lordship granted a stay of execution for 10 days.

Holmes v. National Telephone Company.

Before Mr. Justice Kekewich, in the Chancery Division last Friday, October 28th, Mr. Baker mentioned the case of Holmes v. National Telephone Company, in which he held a motion for an injunction to restrain the defendants from putting up posts in the soil of a road belonging to Mr. Holmes. Defendants had consented to treat this motion as the trial of the action, and to give a perpetual undertaking in the terms of the notice of motion, and also to pay costs. The minutes had been decided. Mr. Stokes appeared for the defendant company.

Mr. Justice Kekewich: Very well.

Miller v. The Westminster Electric Supply Corporation.

In the Chancery Division of the High Court of Justice on Friday, the 28th ult., before Mr. Justice Romer, Mr. Farwell, Q.C., said that in this case he had a motion to restrain the defendant from breach of covenant by excavating land under property demised to them by the plaintiff adjacent to his dwelling house. The company had put in an affidavit in which it was stated that "the whole of the excavations were completed on October 21st." Under these circumstances he thought it would be idle to occupy the time of the Court because, probably, his Lordship would not think it was a case for a mandatory order. He therefore asked that there should be no order on the motion, except that costs should be costs in the action.

Mr. Justice Romer: Very well.

Medhurst v. Smith.

The other day Mr. F. H. Medhurst, electrical engineer, residing at Randolph Crescent, Maida Vale, sued Henry Smith, jobmaster, of Blomfield Street, Marylebone, to recover compensation for injuries suffered by his wife and child in a carriage accident, which, it was alleged, was caused by the defendant's negligence in supplying a brougham so defective that it collapsed whilst the plaintiff, his wife, and child were being driven in it. The jury returned a verdict for the plaintiff—damages £50.

WILSON *v.* EASTON, ANDERSON & GOOLDEN, LIMITED.

In the Chancery Division of the High Court of Justice on Friday, the 28th ult., Mr. Justice Romer, in this case appointed a receiver and manager of the defendant company, on the application of a debenture holder, who held stock to the amount of £69,000, out of an issue of £160,000 debentures. Mr. R. Neville, Q.C., who appeared for the plaintiff, stated that the company was in a difficult position, mainly in consequence of an arrangement for purchase by the Hooley Syndicate having fallen through, but that it had on its books contracts to the amount of £120,000, including the installation of electric plant. Mr. Justice Romer gave leave to the receiver to borrow £75,000 to carry on the business.

TAAFE *v.* DUBLIN DISTRICT TRAMWAYS COMPANY.

This action, which was an inquiry to assess damages owing to the defendant altering the level and approaches to plaintiff's premises in Great George's Street, Kingstown, came before the Lord Chief Baron at Dublin last week. It was declared that it would cost £530 to lower plaintiff's premises to conform to the lowering of the street. The judge considered that the defendants had caused loss to plaintiff's business, and he allowed the sum of £750.

PEARSON *v.* CHARING CROSS AND STRAND ELECTRICITY SUPPLY CORPORATION.

At Brompton County Court last Friday, before His Honour Judge Stonor and a jury, a labourer named Pearson, of Chelsea, claimed from the Charing Cross and Strand Electricity Supply Corporation, Limited, the sum of £150 as compensation for personal injuries, said to have been caused by reason of the defective condition of the ways and works connected with defendant's business. The jury found for the plaintiff and assessed the damages at £60. Judgment was given accordingly with costs.

BUSINESS NOTICES, &c.

Electrical Wares Exported.

WEEK ENDING NOV. 1ST, 1897.	£	s.
Adelaide	10	0
Albany	86	0
Auckland	230	0
Bombay. Teleg. mat....	47	0
Brussels. " " ...	190	0
Buenos Ayres	120	0
Calcutta	61	0
Cape Town	766	0
Colombo...	49	0
Durban	314	0
Fremantle	271	0
Gibraltar	2,288	0
Gothenburg	296	0
Kurrachee	43	0
Launceston	120	0
Madeira	170	0
Malaga	20	0
Malta	13	0
" Teleg. mat. ...	85	0
Melbourne	75	0
New York	130	0
Ostend	10	0
Port Elizabeth ...	910	0
Rangoon	45	0
Rio Janeiro	77	0
Rotterdam	72	0
St. Petersburg	176	0
" Teleg. mat.	121	0
Santos	6	0
Spezzia	1,041	0
Stockholm	140	0
Sydney	268	0
" Teleg. mat. ...	37	0
Yokohama	770	0
Zanzibar	49	0
" Teleg. mat. ...	85	0
Total	£9,181	0

WEEK ENDING NOV. 1ST, 1898	£	s
Adelaide	51	0
Alexandria	40	0
Amsterdam	207	0
Antwerp	35	0
Bangkok	207	0
Bombay	486	0
Boulogne	216	0
Buenos Ayres	323	0
" Teleg. mat.	474	0
Calcutta	188	0
Cape Town	271	0
Christiansand	46	0
Colombo	59	0
Constantinople	14	0
Durban	135	0
East London	10	0
Gothenburg	46	0
Hamburg	50	0
Malta	47	0
Ostend	45	0
Otago	63	0
Paris. Elec. batteries...	25	0
" Elec. fuses ...	75	0
Port Elizabeth	18	0
" Teleg. mat.	180	0
Rangoon	49	0
Rio Janeiro	186	0
Santander	7	0
Spezzia	121	0
Stockholm	613	0
Sydney	446	0
Tientsin. Teleg. mat.	80	0
Total	£4,813	0

Agency Notice.—The Unbreakable Pulley and Mill Gearing Company, Limited, of Manchester, have appointed Messrs. Putz, Curphey & Co., engineers, 19 & 20, Strand Street, Liverpool, as their sole agents for Liverpool and district for the sale of their manufactures.

Alleged Fraud.—At the Exmouth Police Court, E. J. Thomas, electrical engineer, who, as stated in our issue of October 21st, is charged with obtaining goods by false pretences from various electrical and other firms, was on 26th ult. committed for trial at the next assizes.

Announcement.—Messrs. Williamson & Joseph, Limited announce that Mr. A. E. Bennett is no longer in their employ.

Bankruptcy Proceedings.—A receiving order was made on Tuesday at the London Bankruptcy Court, on the petition of Mr. W. H. Hark, Old Broad Street, against the estate of Claude Vautin, metallurgist, lately carrying on business at 66, Old Broad Street, and residing at Hamilton Terrace, St. John's Wood. The act of bankruptcy alleged in the petition was the departure of the debtor on October 27th, with intent to defeat and delay his creditors, and it is reported that the debtor had cash and securities to the value of over £15,000 in his possession when he went away. Messrs. Beyfus & Beyfus represented the petitioning creditor.

Dissolutions of Partnership.—Messrs. J. G. Goulding and G. F. Rimmer (Goulding, Rimmer & Co., electrical engineers, 23, Water Street, Liverpool), have dissolved partnership by mutual consent.

Messrs. F. W. Ames, F. T. Ames, and W. C. Garrard (Ames, Garrard & Co., art smiths and engineers, Goldney Place, Harrow Road, London), have dissolved partnership from June 30th, so far as regards F. W. Ames. The other partners will continue the business and attend to debts.

Liquidation Notices.—A petition presented on October 25th by Mr. J. A. White and Mr. E. I. de Buriatte, solicitors, for the winding up of the Apostoloff Automatic Telephone Parent Syndicate, is to be heard before Mr. Justice Wright at the London Law Courts on Wednesday next, 9th inst.

A meeting of the British Incandescent Electric Lamp Company to be held on December 5th at 12 noon, at 2, Basinghall Street, E.C., will receive an account of the winding up from Mr. A. Riley, liquidator.

Books Received.—"Practical Mechanics," by Sydney H. Wells. Methuen & Co., London. 3s. 6d.

"Railway 'Block' Signalling," by James Pigg, A.I.E.E. Biggs and Co., London. 7s. 6d.

Calcium Carbide.—It is reported that Messrs. Siemens and Halske, of Berlin, are about to establish works at Klosters, Switzerland, for the manufacture of calcium carbide.

The Cambridge Electric Supply Company, Limited, and the Cambridge Union.—The hearing of the appeal case of the Cambridge Electric Supply Company against the Union assessment for rating purposes was resumed in the Outer Temple, London, on Saturday, the 29th ult.—Mr. Rawlinson, Q.C., opened the case for the respondents.—Mr. W. G. Cooke, rating surveyor, stated that he considered the life of electric lighting machinery was at least 40 years, and that a sum representing four-ninths of 1 per cent. annually was a reasonable and sufficient amount to allow for depreciation; this length of life and depreciation would apply to all classes of machinery. Respecting cables, he looked upon them as if they were a pane of glass, and if they broke down they would need to be wholly renewed out of revenue, as they could not be repaired. Under these circumstances nothing should be allowed for depreciation.—Mr. Barnett, an engineering valuer, stated that he had examined the works; he considered 20 years was a reasonable life, but his opinion differed from Mr. Cooke. He thought £500 per annum was ample depreciation on a capital of £45,000, or two-thirds of 1 per cent. He had seen the works, and thought there were not £500 worth of spare plant, cables or material on the premises. He was asked, Was he aware that there were at least 12 drums of cable in stock on the day of his visit, worth from £40 to £50 apiece, alone representing more than the sum he stated? He said he had not seen them. He also considered that a hypothetical tenant should be quite satisfied after paying £2,100 rent if he made £500 a year profit.—Mr. A. H. Preece was asked what he considered a fair life for electricity undertakings, and he thought about 25 years. Asked did he consider Lancashire boilers at 200 lbs. pressure would last that time, he said he considered they would. India-rubber cables he gave a life of at least 15 years, and transformers up to 100 years. It was pointed out to him that companies such as the Westminster allowed 3½ per cent. on their capital for depreciation, although they had no rubber mains, and that Manchester and other large towns allowed more. In the face of this fact, he agreed with the previous witness that £500 was quite enough for depreciation on £45,000.—Mr. Rawlinson addressed the Recorder on behalf of the respondents, and Mr Ryde replied for the company. The learned Recorder reserved his decision, and promised to deliver judgment on December 1st.

Forthcoming Book.—Messrs. Archibald Constable and Co. will publish early in November "The Life of the late Sir Charles Tilston Bright, C.E., M.P.," wherein is included the story of the first Atlantic cable, the first telegraph to India and the Colonies, and the early land telegraphs of the United Kingdom. This work is written by Mr. E. B. Bright and Mr. Charles Bright, F.R.S.E., brother and son respectively of the subject of the memoir. The book, which contains many full page and text illustrations, as well as photogravure plates, maps, charts, &c., will be published in two volumes demy 8vo. The price, which before publication will be two guineas net, will be raised after the date of publication to three guineas net.

Lists.—Messrs. Elliott Bros. have brought out a small pamphlet of 24 pp., in which they describe and illustrate in an exceedingly neat manner their various patterns of recording instruments, including continuous and alternating ammeters and voltmeters, portable pattern recorder, recorders for steam and water pressure, recorders for electric tramway work, water level recorders, and wattmeters. A number of specimen records are illustrated.

A price list of electric switch blocks has been issued by Messrs. Avon, Gray & Co., of Sparkbrook, Birmingham.

Cast-iron water-tight tube conduit fittings and the "James" enclosed arc lamps are particularised and illustrated in a new list brought out by Messrs. Newsome, Pinching & Co., of Crutched Friars, E.C.

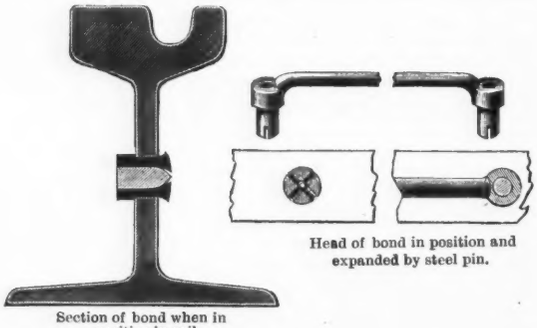
Messrs. Green & Boulding, of Bunhill Row, E.C., send us a small pamphlet in which the Buffalo Automatic injector, Tripp metallic packing, and other special lines are illustrated, described, and priced.

Messrs. Wynn, Timmins & Co., Limited, of Birmingham, send us a copy of the latest edition of their illustrated price list, 140 pp., of engineers', carpenters' and general tools.

Mr. Henry Pynegar, of Dowgate Hill, E.C., sends a list of "Schermuly's" patent universal pulley blocks.

The Municipal Elections.—From the incomplete list to hand of results of the municipal elections which have taken place this week, we find that the following connected with the electrical business have been elected to seats on the respective Councils:—Croydon, Mr. F. R. Docking, electrician, of George Street; Derby, Mr. E. Haslam, electrical engineer; Faversham, Mr. Jabez Smith, electrical engineer; Lowestoft, Mr. J. W. Brooke, managing director of J. W. Brooke & Co., Limited, electrical engineers; Manchester, Mr. J. R. Wilson, electrical engineer, of Longsight.

The "Neptune" Rail Bond.—We illustrate below a copper rail bond, which is made by Messrs. Felten & Guilleaume, of Carlswerk (London representatives, Messrs. W. F. Dennis & Co.), for use on electric tramways and light railways. The chief advantage claimed for the "Neptune" is that after the heads of the bonds are put through the web of the tramway rails they are expanded by stool pins driven in from the same side of the rails as that from which the bonds are inserted. This is particularly important when electrical traction is adopted on existing horse, cable, or steam tramways, as the roadway need be opened on one side only for the fixing of the bonds, and a considerable economy is thereby effected. The advantage of bonds fixed with a steel centre pin is obvious, as they not only have the copper forced into absolute contact with every part of the hole bored in the web of the rail, but a shoulder is formed on both sides of the hole, such, that it is impossible for the head to become loose even if by force the pin were removed. We understand that there are many thousands of these bonds in use giving great satisfaction, the contact with rails being excellent, and they cannot, it is stated, work loose. Messrs. Felten & Guilleaume have specially laid themselves out for the manufacture of these bonds with a view to turning out large quantities. They also manufacture and supply large quantities of copper trolley wire consisting of single lengths weighing over 500 lbs., and jointed by special joints of a strength equal to the wire before drawing. Their different classes of cables for all sorts of purposes, including paper insulated cables with single, concentric, biconcentric, and stranded conductors for low and high tension with all their appurtenances such as connecting, distributing, and feeder boxes, are well known. The firm undertakes contracts for laying and putting in working order their cables under guarantee.

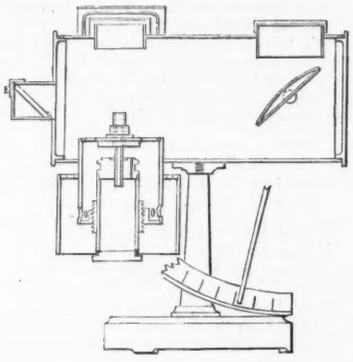


Head of bond in position and expanded by steel pin.

Section of bond when in position in rail.

New Photometer.—Messrs. Nalder Bros. & Co. are making a new pattern Preece-Trotter patent illumination photometer.

The previous form of Preece-Trotter photometer has been in use some years, and has been found satisfactory. The principle objection, however, to it was that the source of light was a small incandescent lamp worked by a secondary battery. Secondary batteries are necessarily more or less variable, and it was therefore found desirable to take a check reading in the laboratory before and after using. In the present form the source of light is a small amyl-acetate lamp which is itself sufficiently accurate as a standard without calibration. All that is necessary is to cut the lamp wick square across occasionally, fill the reservoir with amyl-acetate, light the lamp, and screw it up till the point of the flame touches the fixed point seen above the lamp. The present form, which we illustrate, is very much lighter and much more compact than the previous one. The working of it, it will be seen, is similar to the old pattern, namely, that the illumination to be measured falls on an outside paper screen in which there is a hole, through which a paper screen inside the body of the instrument can be seen. The illumination of this screen can be



varied by moving the outside handle, and thus tipping the screen with respect to the light. When the illumination of the two screens is the same the spot vanishes, and the illumination is then read off direct on the scale, in what is commonly, but wrongly, called "candle feet," that is in terms of illumination given by one candle at one foot distance.

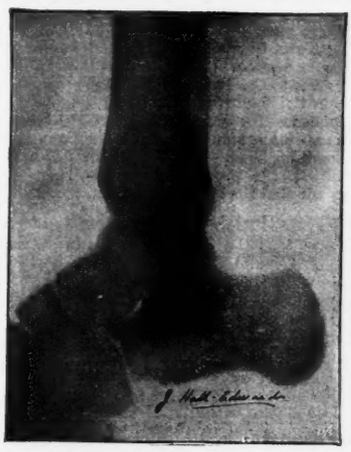
New Portable Testing Battery.—Messrs. Niblett and Sutherland, of 61, Chandos Street, W.C., are bringing out a new portable testing battery. It is claimed that this storage battery can readily be charged from any continuous current electric light circuit, and will retain its charge for a long period. The discharging E.M.F., which may be either the full voltage of the battery or half that amount, as desired, is steadily maintained. The internal resistance of the battery being low, high rates of discharge may be taken from it, thus: An 8 or 16 C.P. 100-volt lamp can be fully incandesced by it for a considerable time, thereby rendering the battery serviceable for making continuity tests of lighting circuits before the main current is connected. The standard pattern, 100-volt battery, measures 1 foot by 6 inches by 6 inches, and weighs only 14 lbs. It is contained in a polished walnut case with a leather handle, and provided with terminals and a special commutating switch, by means of which 100 or 50 volts can be obtained at the terminals as desired.

X Rays in War.—A most interesting demonstration of Röntgen ray field practice was given the other day by the ambulance

X Ray Apparatus in Working Order.

section of the 1st V.B. Royal Warwick regiment. The ambulance party was assisted by a section of combatants and also by the

ambulance section and machine gun party of the 1st V.B. South Staffordshire regiment. The manœuvres took place at Wardend, a suburb of Birmingham. Bullet and bayonet wounds were assumed, and dressing applied accordingly, but the chief interest lay with the supposed bullet wounds. The arrangements complete, the "invalids" were placed in the ambulance waggon, and driven to the hospital tent, where the experiment to which so much interest was attached was carried through. In the case of the bullet wounds, spent bullets had been slipped within the bandages, and Dr. Hall Edwards essayed the task of finding them with the aid of the Röntgen rays. He had provided himself for the purpose with a portable



Radiograph of an Ankle, showing Bullet.

coil, which, by the way, was made and designed throughout to stand rough usage and any kind of climate by Messrs. H. W. Cox, Limited, of 10, 11, 28, Cursitor Street, Chancery Lane. Before carrying out the experiments, the apparatus was carried to the ground in an ambulance waggon, and in order to give it a good jolting, was driven over two fields; nevertheless, it worked to perfection, as will be seen by the radiograph taken. Several patients were dealt with, one having a bullet in his ankle. The Crookes tube was now brought over the injured part, and a black envelope containing a film was placed underneath, and the electric current was switched on for 2¼ minutes. The film was then developed, with the

Radiographing an Ankle.

result shown. Our illustrations are reproduced by permission of the proprietors of the *Graphic*. The demonstration was interesting as it proved that the difficulty of transport (which has been laid so much stress upon by the War Department) can easily be overcome, and it is possible to secure excellent results in the field. Dr. Hall Edwards was congratulated upon the success of his experiments by all the surgeons present, and it was unanimously agreed that the application of X rays to military surgery had been demonstrated possible and of the greatest usefulness. Messrs. Cox's coils and X ray apparatus are well known, and we are glad to see an English firm that are actual makers, coming to the front.

Staff Dinner.—The annual staff dinner of the Electrical Power Storage Company, Limited, took place in the Duke's Salon of the Holborn Restaurant on Monday last, when the staff to the number of 36 sat down to a well served dinner. Mr. J. Irving Courtenay, chairman of the company, presided on the occasion, being supported by Mr. Frank King. After dinner a programme of music and singing, interspersed with the usual toasts, was given.

ELECTRIC LIGHTING NOTES.

Aberystwyth.—The application of the electric lighting company for the lease of a part of the old ropewalk premises here has been considered by the Corporation Finance Committee, who have decided that they cannot recommend the Council to alienate any of the property in the rear of the Town Hall at present.

Arbroath.—On Monday the Gas Corporation of Arbroath held a special meeting, at which it was decided to apply for a provisional electric lighting order.

Bakewell.—The District Council has referred the suggestion to apply for a provisional order, to a committee of the whole Council.

Barnsley.—A Local Government Board inquiry was held on 28th ult. into an application of the Town Council to borrow £25,000 for the purpose of electric lighting. The borough surveyor gave evidence *re* site, and Mr. T. L. Miller, Corporation electrical engineer, gave particulars of the electrical plant. He said it was proposed to lay down a plant for 6,000 8-C.P. lamps, consisting of three Lancashire boilers, 7 feet 6 inches long, and one economiser, having 192 pipes; three sets of 125 indicated H.P. steam engines, each coupled to a shunt-wound dynamo of 75 kilowatts capacity; two batteries, each of 125 cells, and having a capacity of 500 ampere-hours, and for charging the batteries, two transformers, arranged to raise the pressure that the batteries may be charged from the station omnibus bars; two balancing transformers, connected up and arranged so as to regulate the pressure on the two sides of the three-wire system; one switchboard, arranged for the connection of three dynamos; three feeders, two batteries, two balancing transformers, and two battery-charging transformers, together with all necessary instruments and apparatus for the efficient and economical working of the station, and arranged so that any dynamo set may be connected with the tramway switchboard, should work in that direction be undertaken at any future date. In order to maintain the pressure, feeder mains, having a capacity of 20,000 lamps of 8 C.P., would be run to the points most suitable for regulating the pressure. Provision had been made so that the available capacity of the plant could be doubled for an expenditure of £2,000 on plant, and £500 on buildings.

Barrow-in-Furness. — Councillor Smith, at last week's meeting, told the Council that the Electric Lighting Committee had received applications for 3,000 8-C.P. lamps. The plant, which is being installed is for 5,000 lamps at one time, but probably 6,000 or 7,000 can be supplied, as they will not all be lighted at one time. The new committee to be appointed when the new Council is elected will doubtless have to consider extensions at an early date.

Barton.—Mr. G. R. Peers is to report to the Board of Guardians upon electric lighting. He will advise whether current from the new infirmary shall be taken from the Eccles Corporation, or a special generating plant be put down.

Bath.—A meeting of the Electric Lighting Committee was held last week, and Mr. Hammond, consulting engineer, reported that the first set of plant had been working for some few weeks, and on the whole was working very satisfactorily. With regard to the second set, the wheel that they had been waiting for had been delivered, and it was being fixed. The contractors would do their utmost to have the whole thing running a few days before Christmas. The committee might like to know that up to the last statement presented £19,433 15s. had been paid in respect of the extensions, buildings, and everything completed. Certificates were now presented to the amount of £1,400, making a total of certificates issued to date £20,833 15s. An application for a supply of electric light for the new Engineers' Drill Hall, on the Upper Bristol Road, was referred to the Works Committee, Mr. Hammond remarking that the most successful installations in England were those which had been pretty liberal in the matter of extensions to meet new customers.

Belfast.—At a recent meeting of the Electric Committee, the engineer submitted an estimate of the cost of laying mains from the station to Mountpottinger Junction—one side of the route, £2,178; on both sides, £3,477—and he was instructed to ascertain for

next meeting what demand for current there is likely to be in the district which the mains referred to would supply.

Berlin.—According to the report for the financial year, 1897-98, the Berlin Electricitätswerke Gesellschaft is now supplying current to no less than 229,858 incandescent lamps, 10,314 arc lamps, 2,873 motors, representing 10,502 H.P., and to 505 various devices, representing a total of 26,000 kilowatts, an increase of 23⅓ per cent. over the preceding year.

Bermondsey.—Last week the Vestry, at a special meeting, formally adopted a recommendation of the Electric Lighting Committee, that steps be taken to apply to the Board of Trade for a provisional order authorising the Vestry to supply electricity to the parish.

Bootle.—The Town Council last week had a discussion in regard to the charges made for inspections of electrical installations by Corporation employés.

Brentwood.—The Lighting Committee has decided to strenuously oppose any company or individual attempting to obtain a monopoly for supplying the town with electric light. The Committee will consider the best means of lighting the town, and obtain information regarding the electric light and other illuminants.

Bridlington.—The Urban District Council will not apply for provisional order for electric lighting powers this session. At present about five tradespeople have electrical installations of their own.

Brussels.—On July 22nd last the first trial of the complete installation for illuminating purposes in the Gare du Midi in Brussels was made, and pronounced thoroughly satisfactory, and the company which peformed this work has, says the *Society of Arts Journal*, received a contract from the Government for similar installation in the Gare du Midi of Ghent. When the city authorities of Brussels, a few years ago, proposed the question of lighting public places, such as railway stations, parks, &c., by electricity, and of supplying electricity to subscribers the same as gas, a great cry was raised and protestations made against the innovation, urging that it would ruin the gas works and injuriously affect the communal exchequer. Recent statistics show that during the past year not only has the use of electricity increased, but that the profit from the sale of gas is considerably in excess of that of previous years. Deducting the amount expended for establishing plant, &c., the city derived a profit of £8,896. The most important installation recently made in Brussels is in the king's palace. When the work is finally completed there will be 7,500 lamps, of which a large number will be of 5 candle-power, employed in the chandeliers illuminating the ball and reception rooms. There are, according to the United States Consul at Brussels, about 47,391 lamps reduced in units of 16 candles, in the city system, averaging 117 lamps per 100 running meters of canalised streets. This number includes 770 arc lamps and 28 electric motors, the latter varying from one-tenth to 10 horse-power with a total of 105 horse-power. In view of the increasing use of electricity in Belgium, the Consul is of opinion that there is an excellent opportunity for the introduction of electric apparatus of all kinds.

Castleford.—The Urban Council, some days ago, resolved upon the compulsory area to be included in their application for a provisional order.

Cheriton.—The District Council will take preliminary steps for applying for a provisional order, and if necessary, will transfer it later to a company.

Colliery Lighting.—At Ffaldau Colliery, Garw Valley (Glam.), an installation is being fixed for the lighting of the offices and various machines and other works by means of electricity.

Cork.—The recommendation of the Committee of the Cork District Lunatic Asylum *re* electric lighting, to which we referred in our last issue, was last week adopted by the asylum authorities, and gas lighting with incandescent burners will be employed for the present.

Coventry.—Last week the Electric Light Committee presented their statement for the last half-year:—For the quarter ending June 30th, 1898, electricity supplied during the quarter 14,178 units, as compared with 10,017 in 1897: rentals £328, as compared with £240 19s. 9d.; number of consumers 117, against 85; mileage of mains on June 30th—high tension 2 miles 1,592 yards, as compared with 2 miles 337 yards—low tension 3 miles 791 yards, against 2 miles 432 yards. For the quarter ending September 30th, 1898, electricity supplied during the quarter 15,873 units, as against 13,155 units in the corresponding quarter of 1897; rentals £411 7s. 5d., against £340 4s. 9d.; number of consumers 118, against 95; mileage of mains on September 30th, same as on June 30th.

Cowes.—An electrical company has asked whether the Council will be willing to transfer its electric lighting order. The Gas Committee is considering the matter.

Croydon.—The Croydon County Council has resolved to charge 9d. per unit for charging motor cars with current at the electricity works.

Dumfries.—The Town Council is to apply for a provisional order.

Eastbourne.—The members of the Corporation visited Dover this week to see the electric light festoons along the front, also other interesting features of the town. After seeing the Dover electric trams, doubtless the Eastbourne Corporation will feel inclined to imitate them.

Electric Lighting of the Law Courts.—The electric light has now been laid on at the quadrangle entrance, and for the whole of the basement of the main block of the Royal Courts of Justice, in which are situated the Bills of Sale Office and other departments. In the course of a short time the whole of the Royal Courts of Justice buildings will be lighted by electricity.

Erith.—At a recent meeting of the District Council it was unanimously resolved to apply to the Board of Trade on or before December 21st next for a provisional order, and that the statutory notices be issued, and all necessary steps be taken consequent thereon.

Gateshead.—The Parliamentary Committee last week reported to the Town Council that they had had an interview with Mr. W. L. Madgen, a director of the Electrical Power Distribution Company, with reference to the application of that company to the Board of Trade for a provisional order authorising them to supply electrical energy in Gateshead. The report contained the terms of the company. The Committee recommended that the Council consent to the grant by the Board of Trade to the Electrical Power Distribution Company, Limited, of a provisional order. The Council sitting in Committee, has adopted the recommendation.

Geneva.—The Zurich correspondent of a financial contemporary says that the Compagnie de l'Industrie Electrique of Geneva, which was founded originally with a capital of 2,500,000 francs, closes its working year 1897-8 with a profit of 1,038 francs, against 18,060 francs in the previous year. This unsatisfactory result is due to the Geneva branch establishment, which shows losses to a total amount of 112,028 francs, against a profit of 17,631 francs in 1896-7. Consequently, the board of directors, authorised by the shareholders, has decided upon the winding up of the Geneva branch, in order to prevent the recurrence of such misfortunes in the future working of the company.

Gorton.—The Council has referred back to the Electricity Committee a recommendation to advertise for an electrical engineer to report upon a lighting scheme for the district. The schedule of area to be covered by the provisional area has been passed by the Council, and the agreement relating to the working of the tramway system in the district by the Manchester Corporation has also been approved.

Glossop.—The Town Council has decided to apply for a provisional order, and on 9th inst. will discuss whether to transfer it to a company or not.

Grays.—The Lighting Committee has discussed the question of electric lighting with Mr. Preece, who will report in a few days. The question of compulsory area has been decided by the Council, and the clerk is to apply for a provisional order.

Hampstead.—The Lighting Committee is considering six tenders submitted for the supply of coals for the electricity station. The Lighting Committee report that during the month of September, 47 consumers' installations, with an equivalent of 2,840 8-C.P. lamps, were connected to the Vestry's electric mains, and that the total 8-C.P. lamp connections to end of September were 71,367.

Hanley.—On Monday, 24th ult., there was a breakdown of a large machine at the electricity works, which put out a portion of the lighting for a few minutes.

Hereford.—At a Council meeting last week the Special Electric Lighting Committee reported that, having secured the site for the generating station, they proceeded to make inquiries as to the cost of plant, both for the supply of the necessary power and for the distribution of electricity. The Committee, after investigating the various systems in use at the different works they visited, were in favour of the use of gas power, but a firm of electricians so strongly advised the Committee to adopt steam as the power in preference to gas that they requested detailed specifications and estimates. On receipt of the specifications and estimates, however, the figures were so largely increased, and represented a sum so greatly in excess of the amount they were led to anticipate at their interview, that they could not present any definite report until they obtained further details of the cost and explanations as to the reasons for the increase in the figures. The low tension system is recommended.

Hull.—The Board of Guardians last week discussed the question of electric lighting for the board and committee rooms, and it was proposed to ask the Works Committee to ascertain the probable cost, but after discussion the resolution seems to have been defeated.

Hythe.—The Town Council has decided to apply for a provisional order.

Kensington.—Notice of the application being made by the Vestry for a provisional order appeared in the *London Gazette* for October 28th.

Kirkcaldy.—Last Friday the Town Council formally passed a resolution applying to the Board of Trade for electric lighting powers.

Knutsford.—The Urban District Council gives notice in *London Gazette*, November 1st, of its intended application for a provisional order for electric lighting.

(*Continued on page 677.*)

HULL ELECTRIC LIGHTING.

The progress made in extending electric lighting in Hull has been considerable, and it may be interesting, before describing the new works, to give the main features in the development of the public supply of electricity in that town.

The Electric Lighting Committee was formed as long ago as November, 1889, when Dr. Holder was elected chairman. Some months, however, elapsed before official sanction was obtained for the municipal schemes, the lighting order being granted in August of the following year.

Mr. R. E. Crompton reported to the Committee in May, recommending a low tension scheme with mains laid in the compulsory area (within the docks), at an estimated cost of £16,000. About this time Mr. F. Harman Lewis was appointed borough electrical engineer, and he immediately proceeded to carry out the low tension scheme. This included a generating station in Dagger Lane, with engines of 560 I.H.P., by Willans & Robinson; dynamos of 300 kilowatts by Siemens Bros. & Co., Limited; boilers by Davy, Paxman & Co., Limited; accumulators by Crompton, Howell and Co.; and mains in about 2¼ miles of streets by Crompton and Co., Limited.

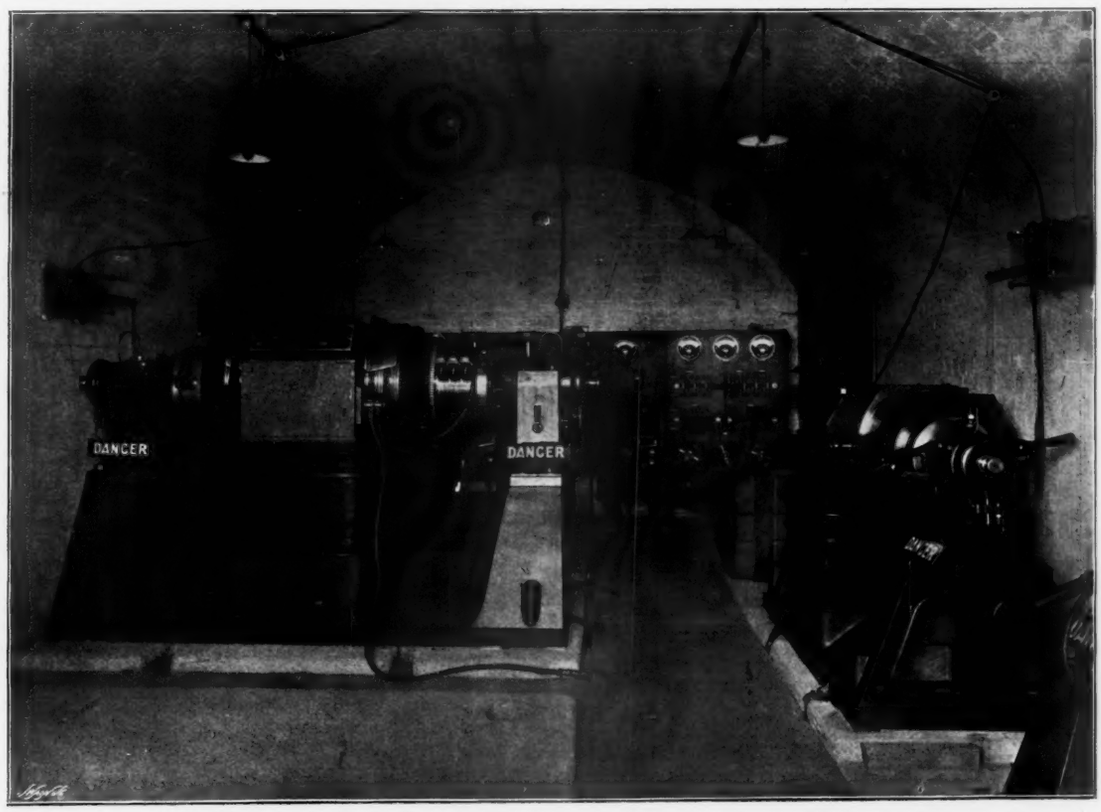
On January 16th, 1893, these works were opened, and have ever since been continuously successful. At the date of opening there were connected to the mains *33* consumers, having the equivalent of about *600* lamps of 8 candle-power wired on their premises. In September of the same year Mr. Lewis left Hull to take up a similar post in Wolverhampton, and Mr. A. H. Gibbings was appointed borough electrical engineer in his stead. In the same month an extension of the mains (about 3 miles) was brought into use in the New Town, west of the docks. These mains were laid by Messrs. Callender & Co. on the Callender-Webber system.

About the middle of 1894 extension orders were placed with Messrs. Willans & Robinson and J. H. Holmes & Co. for a combined engine and dynamo (300 I.H.P. and 180 kilowatts).

At the end of 1894 the works were in the following condition:—

Consumers connected	271
8 C.P. lamps „ „	14,208
Profit on year's working	£996
Units sold during the year	163,857

In April, 1895, further orders were placed with Messrs. Willans & Robinson and J. H. Holmes & Co. for a second combined engine and dynamo (300 I.H.P., 180 kilowatts), and Messrs. Amos & Smith for a boiler (300 H.P.) Towards the end of this year Mr. Gibbings left, having been appointed electrical engineer to the city of Bradford. Mr. A. S. Barnard was appointed in his stead.



From a photo by] [Turner & Drinkwater, Hull.

View of Sub-station.

At the end of December, the following were the statistics:—

Consumers connected	395
8-C.P. lamps „	20,584
Profit on year's working	£1,263
Units sold during the year	246,277

At the beginning of 1896 Dr. Holder, who had been responsible for much of the progress made in Hull, resigned the chairmanship of the Electric Lighting Committee, and Councillor J. T. Skinner was elected in his stead.

An important discussion arose about this time anent a large scheme of extensions which was submitted by the Electric Lighting Committee. It was estimated to cost

£42,000, but it was rejected by the Town Council. A few months after this Mr. Robt. Hammond was asked to report to the Committee on their scheme, and the Electric Lighting Committee again submitted it, with Mr. Hammond's report thereon, to the Council, but again it met with defeat. A fortnight later the scheme was submitted for the third time, and finally accepted by the Council, with the addition of £10,000 to estimate for East Hull. It is apparent from the following figures which represented the condition of the system at the end of 1896 justified the town in adopting considerable extensions :—

Consumers connected	520
8-C.P. lamps „	26,817
Profit on year's working	£1,970
Units sold	340,439

Owing to delay in starting new works and the large number of applications for current, temporary works were laid down in North Street, and commenced generating on November 5th, and were closed on March 5th following. The tables relating to the years 1897 and 1898 (March) are as follows :—

Consumers connected	550
8-C.P. lamps „	28,524
Profit on 15 months' working	£1,981
Units sold, 15 months	463,796

Consumers connected	737
8-C.P. lamps „	43,652
Profit on year's working	£2,039
Units sold	467,352

The capacity of the original plant which is at the Dagger Lane works comprises engines of 1,160 I.H.P., and dynamos of 660 kilowatts.

The new works, which were formally opened last week, have been erected at a considerable distance from the original station, and are in Sculcoates Lane; the system is that known as the "Oxford" (with sub-stations at Argyle Street and Albion Street).

The engines are of 760 I.H.P., and the dynamos of 456 kilowatts. In addition to these, however, there are extensions at present being ordered, comprising engine of 750 I.H.P., and dynamo of 450 kilowatts.

The number of consumers connected to mains is 863, and lamps (8 C.P.) connected, 67,900.

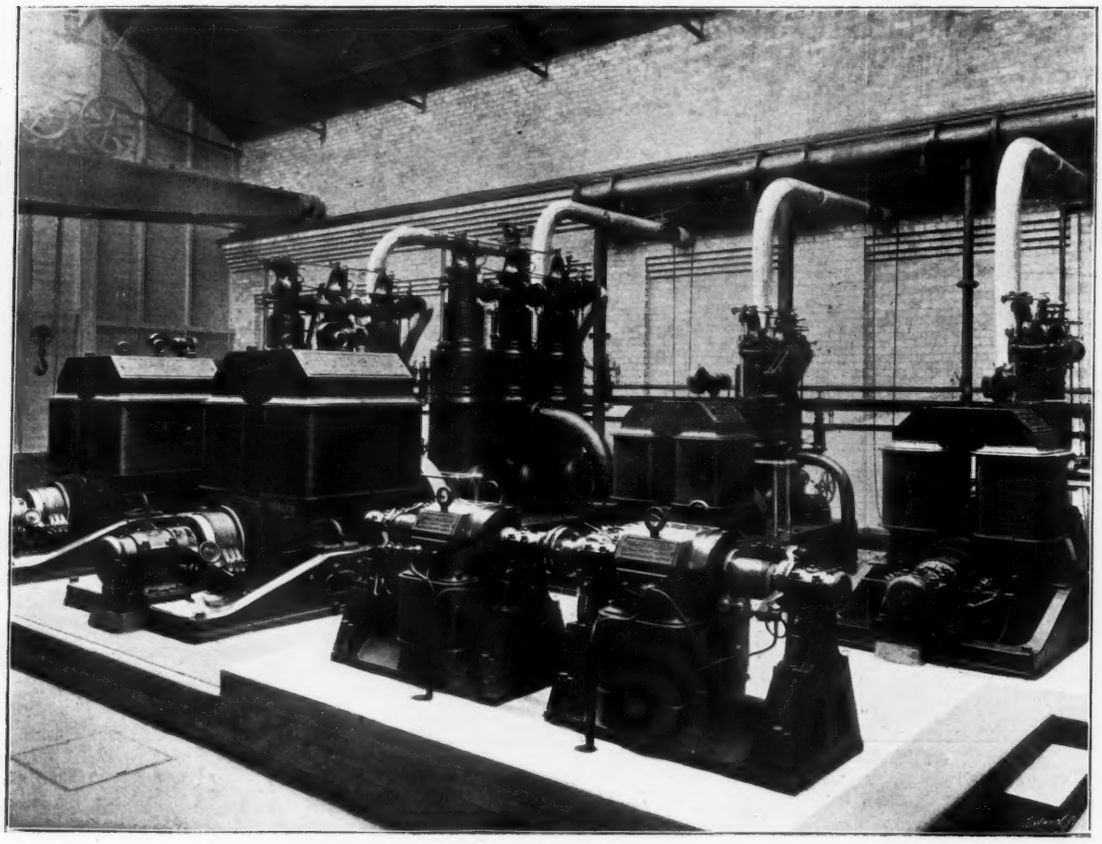
The streets in which mains have been laid consists of

Old town	2¼ miles.
New town (first extension)	3 „
Present extension	8 „
East Hull extension (now about to be laid)	3¼ „
Total	16½ „

The customers include theatres, music halls, circus, hotels (large), schools, churches, private houses, and there are a certain number of motors connected to the mains.

The following are contractors for the new works :—

Mains (high and low tension) ...	Siemens Bros. & Co., Ltd.
Dynamos, transformers and switch-boards, &c.	Thos. Parker, Ltd.
Engines	Willans & Robinson, Ltd.
Boilers (Lancashire)	Tinkers, Ltd.
„ (water-tube)	Babcock, Wilcox & Co.
Steam pipes, condensers, pumps, &c.	Rose, Downs & Thompson, Ltd.
Accumulators	Pritchetts & Gold.
Crane	J. Spencer & Sons, Ltd.
Economiser	E. Green & Sons.
Building (generating station) ...	E. Good & Sons.
„ (sub-stations)	Mark Harper.
Roof principals, tank, &c.	J. Snowden.



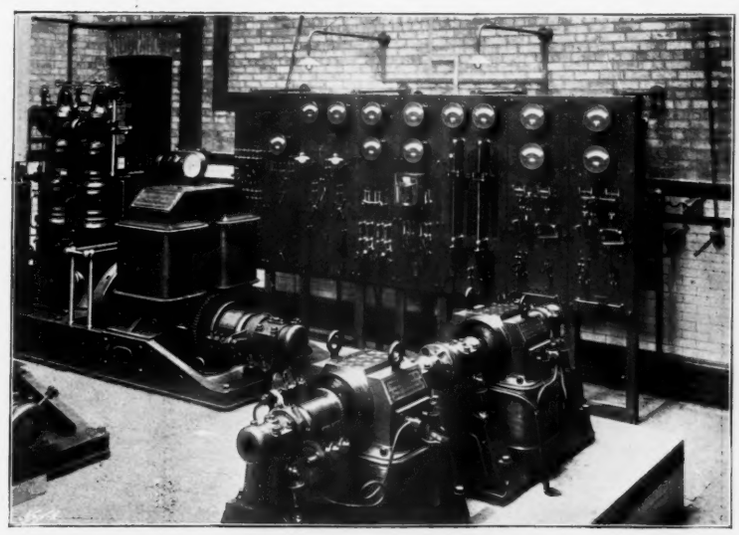
From a photo by] [Turner & Drinkwater, Hull.

General View of Engine Room, with Motor Generator in Foreground.

The boilers are of the Lancashire type supplied by Messrs. Tinkers, Limited, and water-tube supplied by the Babcock-Wilcox Company. There is also a Green's economiser of the high pressure type, consisting of 192 tubes in 24 sections of 8's, arranged on the grouping principle, which gives facility for getting at all parts with ease. The groups are coupled together with expansion elbows to allow of free expansion and contraction. It has been tested with a pressure of 350 lbs. to the square inch.

The steam supply is carried on two parallel lines of 8-inch W.I. solid drawn pipes with welded flanges, resting on

C.I. chairs behind and above the boilers, and connected at the ends with copper V beads of the same size of pipe and No. 2 I.S.W. gauge thick. Into this ring each boiler feeds by a separate copper pipe beat into an S shape so as to avoid strain due to expansion. A complete series of valves are inserted in these pipes, so that each boiler may independently feed any engine through the ring either way round or may be cut off, and any combination of boilers and engines may be used. The plane of the ring is inclined downward towards the boilers, and it is drained at two points by steam traps. The boiler supply pipes and main valves are also independently drained, and the system of drain pipes is such that under no circumstances can any water collect in any part of the pipes. Every pipe is provided with copper bends to allow of expansion without stresses being set up in the pipes. The whole is clothed with non-conducting boiler covering 3 inches thick in every part.



From a photo by] [Turner & Drinkwater, Hull.

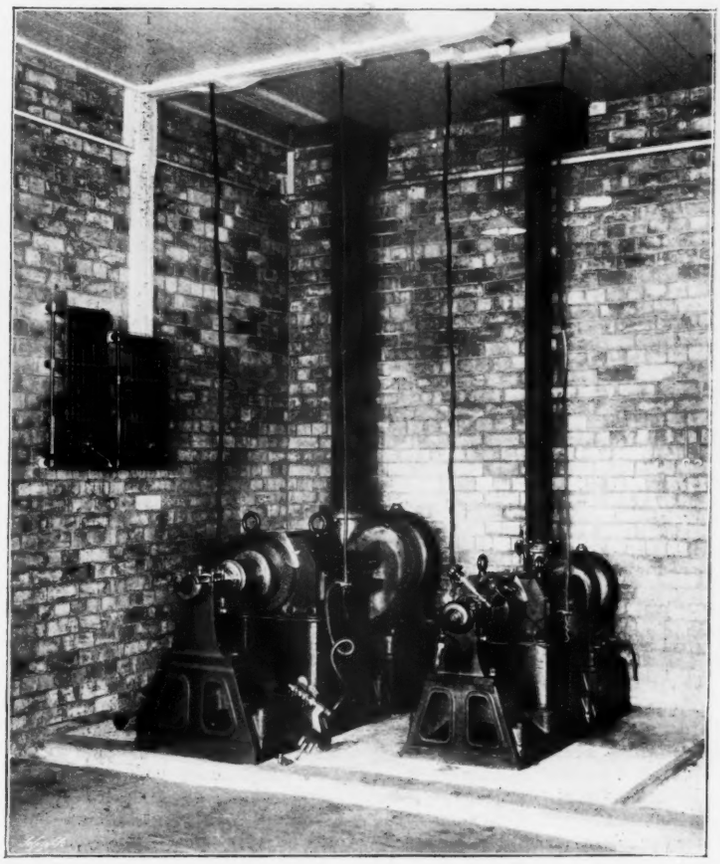
View of Low Tension Switchboard.

From the steam ring the steam pipes are taken off by C.I. tee pieces to supply (1) the main engines, (2) feed pumps, (3) injectors, (4) feed heater.

The feed-pumps are of the direct acting vertical type with pumps underneath. They draw their supply from a tank, which is kept supplied with softened water, by the water softener to be presently described. The pipes are so arranged as to pump either—(1) through the economiser; (2) direct into the boiler; (3) through the steam feed heater. The feed supply is on the same principle as the steam supply, viz., any pump can supply any boiler either with cold or with hot water. The feed heater is Royles's patent fitted with Row tubes. There is also a complete and independent injector feeding gear which can be used either in conjunction with the pumps or otherwise. The water softener is Pemberton's patent and consists of (1) a reagent or mixing tank, and (2) a clarifying or filtering tank, and (3) apparatus for thoroughly mixing the reagent solution with the water to be softened.

The mixing tank is divided into two parts each provided with a stirrer, so that one-half can be used for mixing the solution while the other is settling. The solid alkali is here dissolved either in town's water or with water drawn from an adjacent drain, it is then allowed to settle, after settling the solution is mixed with the water to be softened by means of two nozzles directed at one another, so that the two streams of reagent and feed water become thoroughly mixed.

A small diffusing tank completes the mixing, and the water, with suspended precipitate, passes through several thick layers of cocoanut fibre in several successive tanks, being thus completely freed from milkiness. It eventually passes to the tank. A complete series of ball valves to each tank makes the process of softening almost entirely automatic.



From a photo by] [Turner & Drinkwater, Hull.

Motor-Driven Pumps.

The water for the condensing and also for the softening is pumped out of an adjacent drain by means of two centrifugal pumps, 5 inches and 7 inches diameter, into a large overhead tank. Each pump is driven independently by a Parker electric motor (shown in one of the illustrations). From this tank the water is supplied to the ejector condensers, of which there are two, through a 12-inch pipe.

The exhaust from the engines can be turned either into the condensers or into an atmospheric pipe 15 inches diameter, which runs along under the floor, and turns upwards outside the building. The weight of the vertical portion and also the expansion

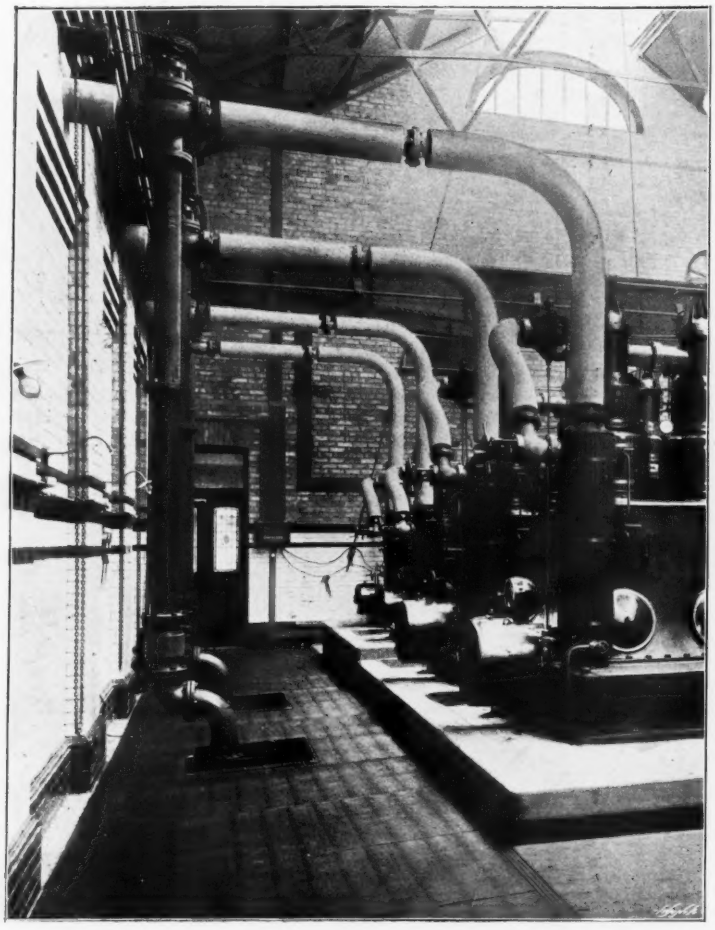
of the horizontal are provided for by casting the bend on a heavy C.I. stool, which is capable of slight movement in a horizontal direction. The whole of the steam pipes, valves, condensers, pumps, and other accessories, have been supplied by Messrs. Rose, Downs & Thompson, of Hull.

The engines are two Willans & Robinson 3 I/s size three-crank, compound type and arranged to work either condensing or non-condensing. They are fitted with Sankey's patent automatic cut-off gear, having a range of ·15 to ·6, are of 360 horse-power each, working at a pressure of 140 lbs. in the steam chest, with a vacuum of 27 inches, and run at 350 revolutions per minute. Each engine is coupled to one of Messrs. Thos. Parker's high tension, continuous current generators, having an output of 2,250 volts and 90 amperes, and which were separately excited from a 300-volt circuit.

There are two smaller sets, comprising two Willans and Robinson crank compound 2 G/s size engines, which also work at a pressure of 140 lbs. in the steam chest, with a vacuum of 27 inches, and running at a speed of 460 revolutions per minute. The 2 G. engines are coupled to Thos. Parker dynamos, having an output of 350 volts and 150 amperes.

Current is supplied from the generating station at Sculcoates Lane at a pressure of 2,200 volts, and transformed down at two sub-stations to a three-wire system, with a pressure of 440 volts across the outer.

The electrical plant at the generating station is supplied by Thomas Parker, Limited, and consists of two high tension and two low tension dynamos, the low tension dynamo serving the double purpose of exciting the high tension machines, and supplying current for the station and immediate neighbourhood, and charging the battery during the day, the two machines being arranged on the three-wire system. The high tension dynamos are of the ordinary two-pole type, coupled direct to a Willans engine; the armatures are drum-wound with patent Eickemeyer coils, the fields being separately excited from a 220-volt circuit. Their output is each 2,250 volts, 90 amperes, when running at a speed of 350 revolutions per minute. The low tension machines are of the same pattern, also coupled direct to Willans engines, and each give an output of 220—300 volts, 150 amperes at 460 revolutions per minute. The rest of the electrical plant at this station consists of one 30-B.H.P. and one 14-B.H.P. shunt motor coupled to centrifugal pumps for condensing purposes, and one 2-B.H.P. shunt motor for driving the economiser scrapers, all running off the 220-volt circuit; also a motor generator, consisting of two machines coupled together and mounted on girder rails, each to run with 225 volts, 100 amperes at 900 revolutions per minute, used to balance the three-wire system.



From a photo by] [Turner & Drinkwater, Hull.

Showing Arrangement of Steam Pipes.

The low tension switchboard consists of eight slate panels mounted on an iron frame. These contain throw-over switches, allowing the station lighting current and the current for running the above motors to be taken from either side of the middle wire; insulation testing set; switches for starting and regulating the motor generator; feeder and distributor panels, and battery regulating switch. The two on the extreme right are the dynamo panels, each containing a main throw-over switch, by means of which the dynamo may be thrown on either side of the middle wire. The main double-pole switches are each provided with automatic maximum and minimum cut-outs.

The high tension switchboard consists of 13 panels, the two outside panels at each end being spares. The dynamo panels are on the right, and each contains main double-pole switch provided with automatic maximum and minimum cut-outs, also throw-over switch, by means of which the fields may be short circuited on themselves. The next panel contains device for earth testing, and the remaining six are the transformer panels. Each of these contains an ammeter, main double-pole switch with maximum cut-outs on each pole, starting and regulating switch, voltmeter, which gives the pressure on low tension feeders, and voltmeter short-circuiting switch at the transformer sub-stations, described later on.

The Argyle Street sub-station, which is about 1½ miles from the generating station, contains two transformers, each giving an output of 440 volts, 185 amperes, at 500 revolutions per minute, and two each giving 225 volts, 184 amperes at 600 revolutions when supplied with current at 2,000 volts pressure. These are of the type usually manufactured by Thomas Parker, Limited, being two-pole drum wound with Eickemeyer coils, the magnets having the firm's patent hinged pole pieces, which allow of the armature being raised by a direct vertical lift. The fields are first excited by series turns of the high-tension leads, these turns being automatically cut out when the machine is excited on the low tension side. The method originally adopted at Oxford left these series coils always in circuit, but the above arrangement was patented and used for the first time at Walsall by the contractors. This arrangement allows the use of more series windings, and does not lower the efficiency of the transformer when running under load.

The switchboard contains three wattmeters and the patent long-range switch for each transformer. These long-range switches are of the type employed by Messrs. Thomas Parker, Limited, for the high tension continuous current system, and have been previously described as in use at Oxford, Walsall, Wolverhampton, &c.

There is a second battery at this station, which is divided

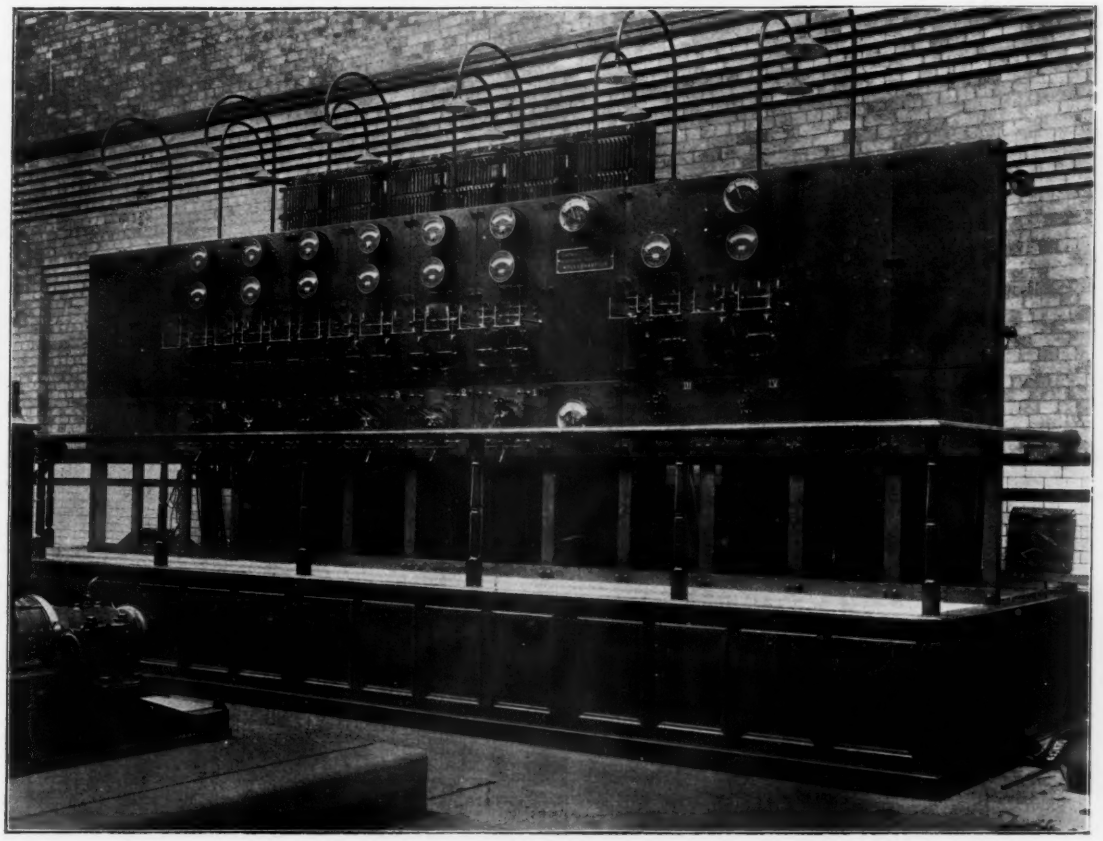
into four sets of cells, consisting of two sets of 80 and two sets of 40, enabling the battery to be charged off either side of the system in three sets of 80 cells, and discharged in two sets of 120, the regulation being made by means of a rheostat.

The second sub-station at Albion Street is about the same distance from the generating station as the Argyle Street station. This contains two transformers, giving an output of 225 volts, 368 amperes, at 500 revolutions when supplied with current at 2,000 volts, and one motor-generator, which consists of two machines coupled and supported on girder rails, one running with 225 volts, 100 amperes, and the other with 450 volts, 50 amperes, at a speed of 800 revolutions per minute, this set being excited off its own circuit so as to feed either the 440 or 220 volt. All these machines are of the same type as those previously mentioned, the switchboard also being similar to that at Argyle Street.

concrete foundations are provided at all corners and bends and where otherwise necessary, and they are provided with cast-iron frames and covers, and are ventilated by means of a stoneware pipe connected to a small ventilator frame.

The high tension feeders (of which about 17,000 yards have been laid) are 0·06 square inch and 0·03 square inch sectional area, concentric, insulated with impregnated fibrous material, lead covered and externally taped and compounded. The L.T. feeders consists of about 4,600 yards of 0·5 square inch concentric lead covered cable, armoured with two layers of 0·05 inch hoop-iron, and is laid direct in the ground. Three 9 and 12-core pilot wires are laid along side the feeders, and a four conductor "dry-core" (air space) telephone cable permits communication between the generating and sub-stations.

About 24,000 yards of distributors have been laid of the



From a photo by] [Turner & Drinkwater, Hull.

View of High Tension Switchboard.

The two batteries of accumulators have been supplied by Messrs. Pritchetts & Gold, the one at the new generating station at Sculcoates Lane consists of 123 cells, and the one at the Argyle Street Bridge sub-station consists of 246 cells. Each battery is capable of an output of 50 amperes for six hours at an E.M.F. of 225 volts and 450 volts respectively. The plates are of Messrs. Pritchetts & Gold's latest type, and are contained in glass boxes fitted with wood trays mounted on oil insulators.

The mains consist of six high tension circuits running from the generating station in Sculcoates Lane to sub-stations in Albion Street and Argyle Street. Low tension feeders run from the generating station and these sub-stations to various points in an extensive network of distributing mains.

The high tension feeders, pilot, and telephone wires are drawn into Doulton's patent stoneware conduits. These conduits are made in 3 feet lengths and are jointed together by means of stoneware cradles with Portland cement; no less than 45,000 yards of 2¼ inches by 2¼ inches duct has been used, spare ways being provided for future extensions. Draw-boxes built of 9 inches brickwork on

triple core, impregnated fibre insulated lead covered and armoured type, the positive and negative conductors being 0·15 square inch section. The advantages of this class of distributing main ("clover-leaf") for three-wire systems are widely recognised. It is held to combine flexibility with facility of jointing, the service and other boxes employed being of a much simpler contruction than those for triple concentric mains. It was first made by Messrs. Siemens for the Bolton Corporation some years ago, and has since been advantageously adopted by many Corporations.

All the cables before and after laying have been subjected to exhaustive tests with satisfactory results. The straight joints are made in cast-iron boxes in two halves bolted together. The internal fittings consist of copper sleeves and sockets for sweating the conductors into, and are embedded in the hard-setting insulating compound with which the boxes are filled.

About 60 disconnecting boxes, three and four-way, have been inserted in the network, and allow of any section of the distributor being rapidly cut out or disconnected for testing purposes. The internal fittings of these boxes are so arranged that either disconnecting copper links or fuses can

be used. They are set in brick pits with manhole frames and covers of similar construction to the draw boxes.

The service cables are of the twin pattern, India-rubber insulated, lead covered and armoured, and are connected to the mains through cast-iron "T" boxes. The whole system of mains has been carried out by Messrs. Siemens Bros., Limited.

COMBINED ALLEN-SILVERTOWN PLANT FOR WOOLWICH ARSENAL.

The engine is by Messrs. W. H. Allen, Son & Co., of Bedford, and is capable of indicating 600 H.P., at a speed of 120 revolutions per minute when supplied with 120 lbs. pressure of steam and condensing, and the combination will be found to be one of the largest continuous current sets in the United Kingdom. The cylinders are 22 inches and 43 inches diameter × 30 inches stroke, the piston speed, therefore, being 600 feet per minute; they are mounted on strong cast-iron columns at the back with bright steel columns in front. The bearing surfaces are automatically lubricated by oil under pressure. The working parts are screened by light iron shields. The engine exhausts into its own condenser, which is mounted on cast-iron supports at the back of the baseplate. The valve for the high pressure cylinder is of the piston class, while that for the low pressure cylinder is a D-valve with relief arrangement on the back. The piston valve for the high pressure cylinder is controlled by variable expansion gear with link motion, which can be altered by hand when the engine is running in order to secure economy of steam consumption. The low pressure silde valve is balanced by a small piston on the top. After passing through the high pressure cylinder, the steam is led into a cast-iron receiver in which it is reheated before passing into the low pressure cylinder. Live steam from the boilers is passed through copper pipes in this receiver in order to dry the steam therein. The surface condenser has a cooling surface of 1,200 square feet and maintains a steady vacuum of 26 inches of mercury under all conditions of load. The tubes are $\frac{3}{4}$-inch external diameter, No. 18 gauge, of solid drawn Delta metal. The air and circulating pumps are both fixed to the back of the engine, and are driven by levers from the low pressure crosshead. The air pump is single acting, and fitted with liners and valves of brass. The circulating pump is double acting with plunger and liners made of brass and India-rubber valves. The circulating water is forced by this pump through the condenser tubes, the exhaust steam passing on the outside.

The fly-wheel is of ample dimensions, being 9 feet diameter by 1 foot 6 inches wide, this large size being of great value for power work, where the demands of the fluctuating load are so changeable and great.

Combined Plant for Woolwich Arsenal.

The dynamo is of the Silvertown 8-pole direct coupled type manufactured by the India-Rubber, Gutta-Percha and Telegraph Works Company, Limited, the yoke and pole pieces being of cast-steel, and the magnets so arranged as to slip into place horizontally, the magnet windings are on separate frames, each thoroughly insulated with vulcanised India-rubber cured on to the metal frame. The armature is of the drum type, the core being of iron sheet, securely fixed to a cast-iron centre, and keyed on to a steel shaft, the bearings being self oiling, with separate pump for oil supply. The nominal output of the combined plant is 375 kilowatts at 330 volts and 120 revolutions.

Before being taken over, the engine and dynamo were run at full load for six hours, at the end of which period the temperature rise did not exceed 50° F., and the set afterwards ran sparkless for a considerable time with a load of 400 kw. The weight of this armature is over 13 tons, and the total weight of the dynamo nearly 40 tons.

SOME NEW FITTINGS.

The late Lord Iddesleigh once delighted his auditors by basing some lengthy remarks on "Nothing." Perhaps he might have been able to say something appropriate on electric light fittings; speaking for ourselves we admit a difficulty. It is not for lack of a proper feeling of admiration that we fail to find expression, or that we do not appreciate the excellence of

Fig. 6.

many fittings that are now being made, but place an ordinary man in a showroom furnished with dazzling specimens of electroliers, brackets, pendants, &c., and it will be surprising if his remarks rise above the commonplace. To write in a befitting manner concerning elaborately-designed fittings, we must array one's thoughts in artistic garb, we

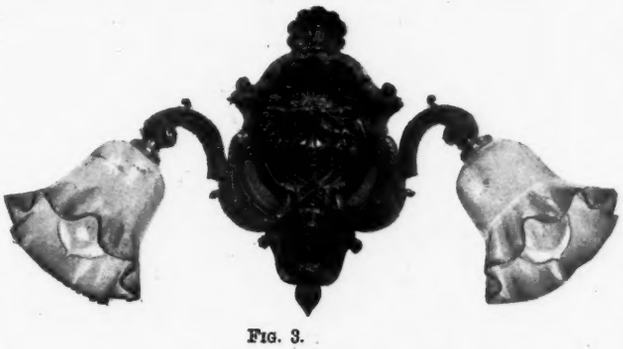


Fig. 3.

ought to possess or hire a soul that will respond to the suggestiveness of the acanthus leaf, that will be tinged with sadness at the melancholy drooping of the Lily of the Valley. Louis XIV. fittings ought to conjure up a picture of a brilliant if dissolute Empire, but we possess neither the properly constituted soul for leaves nor the necessary romantic disposition to do justice to Louis XIV. fittings. These things considered, therefore, it is doubtful

Fig. 2.

whether we can render the necessary meed of praise to the collection of fittings which are so admirably illustrated in a new edition of the General Electric Company's catalogue

Fig. 5.

relating to fixtures and glassware. We remember the derisive terms in which a well-known art critic some years ago spoke of electrical fittings; in his indignation he compared electrical men to Goths, or some similar artistic body; it would be interesting to hear his opinion now. In

a collection comprising nearly 900 pages, it is not easy to select the best, nor do we pretend that the illustrations we give represent them, but they may help to demonstrate the varied character of the fittings made by the General Electric Company. Fig. 1 is a fitting designed specifically

Fig. 1.

for the illumination of pictures; the bracket and shell are of hand wrought metal, and the utilitarian aspect of the fitting is shown by the shell being made adjustable to almost any angle; it is silvered inside, and thereby gives very excellent results. The bracket shown in fig. 2 is light, and in some people's opinion graceful; it is made either in wrought

Fig. 4.

brass or iron. Of quite a different character is the bracket illustrated in fig. 3, it is known as the "Richelieu," and reproduces some of the characteristics of Louis XIV. decorative work; made in rich gilt, it is no doubt a most effective piece of work. Although of an ornamental character, fig. 4, shows a type of electrolier which possesses a distinctly useful feature, the shades are so made that it is possible to adjust them over the lamps as required. The decorative features of this fitting are derived from cast leaf work which produces a pleasing effect. Fig. 5 is an unique and excellent specimen of a centre light, its use is probably limited, but none the less it is probably one of the most striking designs shown in the catalogue. It is made in various combinations, some carrying three, five or seven lights, the one shown carries five lights. The metal used in the construction of these fittings is either copper or brass.

Fig. 7.

The type of electrolier shown in fig. 6, is usually made of wrought-iron or armoured steel, and is by no means of an inelegant type. Fig. 7 illustrates a patent adjustable dining room light. The novelty of this lies in the counterweights, which in addition to their balancing functions, carry incandescent lamps that can be lighted independently of the other lamps if desired.

The New President of the Employers' Federation.—A meeting of the Engineering Employers' Federation was held at the Westminster Palace Hotel last week, for the purpose of electing a president in succession to Colonel Dyer, deceased, and also to consider the best means of placing the federation on a more effective working basis. Sir Andrew Noble, K.C.B., was elected president. After arguments both in favour of the scheme of re-organisation and against, it was determined to dissolve the federation as lately constituted, and to create a new federation of employers on a general and permanent basis. The details of the reconstruction have not yet been arranged, but it was resolved that it should be sufficiently comprehensive to include all employers of engineers. It will concern itself with the whole question of the relations between engineering employers and their workpeople, and will watch and safeguard the interests of the trade in all matters concerning its welfare.

ELECTRIC LIGHTING NOTES.

(*Continued from page* 668.)

Lambeth.—The Vestry on Thursday of last week were to have appointed a Committee of eight members to inquire into the statements and charges made on the subject of the transfer of the electric lighting provisional order. In the absence of Mr. Cooper, at whose instigation the resolution to form a Committee of Investigation was passed, the motion was allowed to stand over. In connection with this matter Mr. Price proposes to move "that all members who voted against the Vestry exercising the electric lighting order be invited to sign a document pledging themselves to take no action, either legal or otherwise, if Messrs. Hubbard, Lock and Wightman will attend and state to the Special Committee the full particulars of the information which they have stated in the Vestry is within their knowledge." The General Purposes Committee reported having reconsidered an application from the New London Brewery Company for permission to lay a cable under the road from the company's premises in Durham Street to their workshops at the rear of Upper Kennington Lane. The Committee recommended that the application should be granted on the company paying a rental of £10 per annum, but this was again referred back to the Committee.

Lancaster.—The managers of the Girls' Higher Grade School in Middle Street have decided to instal the electric light into their re-modelled premises.

Marylebone.—Last week the Vestry resolved, on the motion of Mr. Brooke-Hitching, C.C., to empower the Electric Light Committee to "enter into preliminary negotiations with the Metropolitan Electric Supply Company for the purchase of their undertaking in the parish."

Newington.—The Electric Lighting Committee recently recommended the Vestry to appoint Mr. J. H. Lee, late of the Southampton electricity station, resident electrical engineer at the electrical works now being erected, at £250 per annum. The Vestry has, however, referred the appointment back. It seems that objection is made to the post not being advertised. A resolution was passed advertising the vacancy and giving the Electric Lighting Committee power to select three candidates from the applicants.

Newmarket.—The erection of electric light works is being vigorously proceeded with, and the electric light company expect to be able to commence the supply of current in December.

Pembroke.—The Commissioners have arranged to charge for private lighting, 6d. per unit; for power and heat, 3d. per unit. For the hire of meters the rates are from 1s. per quarter for five lights to 10s. per quarter for 200 lights.

Peterborough.—The Corporation after considerable difficulty have secured another site for their proposed electric light works.

Plumstead.—The Vestry has before it a letter from the Woolwich District Electric Lighting Company, who have applied for a provisional order, with reference to the opposition of the Vestry, who also are applying for powers. The company say that if the Vestry proceeds with its application promptly, and undertakes to commence the works within a very limited time, their application may be withdrawn. Attention is directed to the fact that the Parliamentary Joint Committee last session recommended that the Board of Trade dispense with the consent of local authorities.

Rangoon.—An Indian exchange says that the *Rangoon Times* has now a dozen presses worked by electricity, which also furnishes the light. The electrical plant is American, while the presses are English.

Rathmines.—On Monday, 7th inst., a Local Government Board inquiry is to be held into the application of the Rathmines and Rathgar Town Commissioners for sanction to the raising of a £50,000 loan for lighting the district electrically.

Reigate.—The question of site for electricity works is still occupying the attention of the Electric Lighting Committee.

Retford.—A special meeting of the Town Council was held on Saturday, when the Mayor explained that it was desirable the Corporation should make application for a provisional order authorising the Council to supply electricity for private and public purposes within the borough. They had made what they considered a reasonable arrangement with the Electric Lighting and Power Distributing Company, but in case that arrangement were not carried out to the satisfaction of the Council they ought to be in a position to take the matter up and supply for themselves. It was decided to make the application forthwith.

Rugby.—The *London Gazette* for October 28th contains notice of the District Council's intention to apply for a provisional order.

Shipley.—The Electric Lighting Committee has decided upon a proposed compulsory area of supply of electricity, and steps have been taken towards applying for a provisional order.

Shoreditch.—On Tuesday, at a meeting of the Vestry, Mr. H. E. Kershaw moved the adoption of the report of the Electric Lighting Committee. The Committee recommended the Vestry to sanction an expenditure of £2,200 in the laying of conduits and mains in certain streets in the Haggerston district to be eventually supplied from a new sub-station, and that in the meantime the sub-stations in Hackney Road and Reeves Place should be drawn upon to provide the necessary current. The Committee pointed out that the electrical engineer (Mr. Russell) had ascertained that promises had been obtained from more than sufficient persons to warrant the carrying out of the works. In moving the adoption of the report, Mr. Kershaw stated that the effect of the Committee's recommendation would be the means of opening up the whole of Haggerston, and that that was an opportunity for which the Committee had been waiting. During the discussion of the recommendation, it was suggested that the question of lighting the Haggerston streets should have been combined in the scheme, and an amendment by Mr. Trowbridge was moved to refer the report back to the Committee so as to bring up a complete project for the public and private lighting of that part of the parish. On a show of hands, the amendment was rejected by 26 to 17 votes, and the original recommendation adopted. It was decided to sanction an expenditure of £520 on the purchase of a further supply of meters. The Electric Lighting and Baths Joint Sub-Committee submitted a report in reference to the question of sinking an artesian well in the basement against the new battery room at the back of the premises in Coronet Street. Bearing in mind the present cost of water and the probability of obtaining an ample supply of water on that site, the Joint Committee expressed the opinion that it would be economical to proceed with the work, and they recommended that the Lighting Committee should be given instructions to advertise for tenders for the carrying out of the work. This was agreed to.

Sleaford.—The Ratepayers' Association is asking the District Council to go into the question of applying for a provisional order.

South Shields.—At last week's Town Council meeting the Electric Lighting Committee submitted in its report a comparative statement of the sales of electric current, which showed that in the three months ending September 30th, 1897, the number of consumers was 86; the units consumed 11,949, and the total amount of sales, &c., £492 11s. 6d. For the corresponding period of the present year the consumers numbered 179; the units consumed were 22,274, and the total amount of sales, &c., £879 16s. 11d.

Southgate.—Mr. H. J. Skelton, the chairman of the Works Committee, has prepared a lengthy report on the question of electric lighting. He goes into the question of legal procedure for obtaining powers, into the cost of current per unit according to experience of other towns, and the maximum demand system of charging. He says that a company that could lease the provisional orders or powers acquired by districts like Tottenham, Edmonton, Enfield, Wood Green, and Southgate, would have an area sufficiently large to enable it to supply current at a low price, and earn a fair dividend. He thinks the company should be allowed to burn the town's refuse free of charge. Although Mr. Skelton makes no recommendation, he appears to approve of the Council applying for a provisional order, and afterwards transferring it to a company. This arrangement would give the Council a hold upon the company in the settlement of terms for public lighting, &c.

Spennymoor (Durham).—Last week at the District Council meeting the Works Committee reported that the clerk had informed them that the cost of obtaining a provisional order for electric lighting would be £250. The matter was left with the Committee to make further inquiries and report to a subsequent meeting.

Stoke.—The workhouse gas bill comes to £455 per annum, and the Building Committee is considering the question of electric lighting.

Stone.—The British Electric Traction Company has informed the District Council that owing to the attitude of some of the local authorities the Potteries Electric Traction Company, Limited, were unable at present to carry out a complete scheme, and it was, therefore, not proposed to proceed with their application for powers for the Stone district.

Stretford.—A wordy newspaper warfare is being waged on the subject of the supply of electricity in this extensive and scattered township. No conclusion has yet been arrived at. Opinion seems to be pretty equally divided on the subject of joining Manchester, and even experts are at loggerheads as to cost, &c. It will be some time, evidently, before the local governing authority comes to a decision on the subject.

Sutton (Surrey).—The Urban District Council have decided to call in an expert to advise them *re* electric lighting, and to report whether the provisional order shall be carried out by themselves or transferred to a company.

Trapani.—The Mayor of Trapani is negotiating with Messrs. Siemens & Halske for the lighting of the gardens and promenades of the town by electricity. *Sell's Commercial Intelligence*" suggests that there may yet be time for British firms to tender.

Twickenham.—At the meeting of the District Council last week, a letter was received from the Electric Power Distribution Company offering the Council the option of taking up the order at the end of a month on payment of all costs. A resolution was moved to accept, but as the Council had already agreed to obtain an order, the chairman ruled the motion out of order.

Wales and the Border Counties.—At Rhyl Urban District Council on October 28th, the General Purposes Committee recommended that in face of the notice of intended application for

electric light for Rhyl served upon the Council, and recognising that the time has arrived for the Council to take action themselves for supplying the district with electric light, that the Committee be empowered to engage an engineer for taking immediate steps to formulate a combined lighting and dust destructor scheme, with power also to engage what legal assistance may be necessary. In the discussion it was stated by Mr. E. Williams that it would cost £10,000. It was decided afterwards that a provisional order should be applied for. This, it was stated, would not cost more than about £50. It also came out incidentally that two applications had already been made to supply the town with electric light.

At Llandudno the District Council have received a report from the Electric Light Committee with regard to the Colwyn Bay and Llandudno Light Railway. The Committee recommended that the Council receive the clause in the agreement made last May giving the Council the right to supply the electric energy for the railway on the understanding that the Light Railway Company pay the Council £500 a year. The report was adopted, and it was remarked in discussion that the cost of the works to supply the electric energy for the railway would be about £8,000.

Walker.—The Urban District Council has resolved to apply to the Board of Trade for a provisional order for public and private purposes.

Willesden.—Mr. Ruthven Murray, the newly appointed electrical engineer, is to report to the Council on the sites suggested for electricity works. Builders in the district are being advised to wire new houses for electricity. If the Metropolitan Electric Supply Company proceeds with its application for a provisional order the Vestry will strenuously oppose it.

Winsford.—It is stated that an installation for lighting the main streets of this district would cost £7,700. A member of the District Council intends moving that a provisional order be applied for.

Worcester.—A meeting of the Electricity Committee of the City Council was held on Tuesday to consider the applications for the post of electrical engineer in succession to Mr. Ruthven Murray, who has accepted a similar position at Willesden. The salary is £350 per annum. There were about 30 applicants. Five candidates were selected for recommendation to the City Council.

Wolverhampton.—The recent breakdown of the electric light in Wolverhampton was referred to at the meeting of the Town Council on Friday evening, when the chairman of the committee (Alderman C. T. Mander) explained the cause of the collapse, which has been already stated in the pages of the ELECTRICAL REVIEW, and made the following interesting statement:—He hoped, he said, that this breakdown would not put back electricity in Wolverhampton, and that the public would still have confidence in the undertaking. The demand for electricity had always run ahead of the supply, and they had never had a thoroughly efficient "stand-by" in machinery, and he thought the committee must harden their hearts, and prepare to go in for much more machinery, and they, as a Council, must back the committee up. They had already decided upon an expenditure of £30,000 roughly, and he was convinced that it would be just as well to go in for a bigger expenditure by £8,000 or £10,000 more, the whole or the greater part of which might almost fairly be charged to the Tramways Committee, because it would be all capable of being used for tramway work, and practically be a "stand-by" for the tramway before the tramway comes in. They wished to make their electric station absolutely efficient, and they had every reason to hope that the extraordinary behaviour of the plant would not occur again.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Bath.—The Electric Lighting Committee last week passed the following resolution: "That the Works Committee be asked to ascertain particulars as to the working of the electrical tramcars in such cities as have adopted the system, and that the Surveying Committee be asked to appoint a certain number of members of their committee to meet this."

Belgium.—Good progress is being made with the construction of the new electric tramway in the town of Ghent, and it is hoped that the lines will be opened for traffic before the end of the year.

Birkenhead.—Last week the Council resolved to promote a Bill in Parliament for the purpose of constructing electric tramways in the borough, also acquiring compulsorily or by agreement certain property, and for acquiring by agreement the interests of the Birkenhead United Tramways, Omnibus, and Carriage Company, Limited, and the Wirral Tramways Company, Limited.

Buenos Ayres.—A contemporary says that La Capital Tramways Company, Limited, has now 14¾ miles of tramways in Buenos Ayres operated by electricity, the section between Comercio and the Government House, Plaza de Mayo, recently under conversion from horse to electric traction, having been successfully inaugurated on 27th ult. La Capital (Extensions) Tramways Company, Limited, successfully inaugurated their electrical passenger service out to the Nuevo Chicago on September 11th last.

Derby.—The Parliamentary Committee has, subject to the approval of the Council, entered into an agreement for the purchase of the tramways for a certain sum. The sanction of the shareholders of the tramways company has also to be obtained.

Dover.—At last week's Council meeting the surveyor explained that there was great wear on the roadway at the side of the tramway pitches, and this was the reason for packing it up with granite siftings as a temporary measure. He was having it broken up and rolled from end to end. This process would have to be continually repeated.

Dudley and Sedgley.—Within the past few days the British Electric Traction Company has purchased the Dudley and Sedgley tramway lines. The British Electric Traction Company own other lines in South Staffordshire, and it is proposed to electrically equip the newly acquired tramway and work it in connection with the other portions of their system.

Great Yarmouth.—At a special meeting of the Town Council on Monday, the question of electric tramways for the borough was debated, and a municipal scheme to cost £41,000 was adopted by 22 against 1. The solitary dissentient feared the project would not be remunerative, but several other members of the Council who spoke were sanguine of a profit of from £1,000 to £2,000 a year would be realised, special mention being made of the marked financial success of the electric tramways at Dover. The lines will traverse the centre of the town and the Marine Parade, and be in communication with one of the three local railway stations. Steps to obtain the necessary Parliamentary powers are to be obtained forthwith.

Grimsby.—The Town Council has received a communication from the Provincial Tramways Company with reference to the terms of the agreement under which the company are to have a 21 years' lease granted to them, and are to adopt electric traction. The Council will go into the suggestions made before setting its seal to the agreement.

Hammersmith.—At a meeting of the Hammersmith Vestry last week a long discussion arose over the application made by the London United Tramways, Limited, for consent to the use by the company of a system of electric traction upon the tramways in the parish. The Committee, before whom the question had been for some time, sent up a recommendation to the effect that the Vestry should not consider the application until the company, without prejudicing any future action of the Vestry, should undertake to pay the amount of the expenses incurred by the Vestry in opposing the company's Bill in last session of Parliament. The committee also recommended that the company should be requested to deposit plans with the Vestry showing details of the system proposed, to be adopted. Several members spoke strongly against the overhead system in particular, and opposed the idea of making Hammersmith the spot for experimenting as to the utility of electric traction generally. A few members favoured the conduit system. Ultimately, however, the two recommendations of the committee were adopted without dissent.

Harzburg.—The municipal authorities of Harzburg have made an agreement with the firm of Karl Franke, Bremen, to build an electric line from the station through the Bad Harzburg to the Radauthal. At the same time, the firm has to instal a gasworks, since the public lighting of Bad Harzburg is done partly by the incandescent gas light and partly by electric arc lights. A company has been formed to carry out the undertaking.—*Elektro. Zeit.*

Hayling Island.—It is reported that an electric tramway is in contemplation, to start from the ferry at Hayling Island, and to be taken from thence to the railway station and thence along the sea front to Eastoke, at the eastern end of the island, where building operations are now in progress. The ferry traffic has materially increased during the past season.

Hull.—The Works Committee will not assent to the proposed tramway from Hull to Hessle suggested by a London firm. The reports of the city and electrical engineers with reference to the tenders for rolling stock for the municipal electric tramways contain the following comparative notes:—

Motor cars for 51 passengers (45 cars required). The Westinghouse Company's tender appears to be satisfactory. They offer the choice of Brill or Peckham trucks, and are willing to supply cars with bodies partly of one make and partly of another, and are further willing to adopt any improved design of trolleys which may be placed upon the market before a time to be agreed upon. They will also supply chilled iron wheels in place of the steel wheels specified at a reduction of £10. The specifications for the car bodies do not indicate any difference in value between the several makes, but the reputation of the Brill and Milnes's cars is somewhat better than the Brush cars. The tender of Messrs. Warburg, Dymond & Co. is somewhat lower than the Westinghouse Company's tender for Milnes and Brill cars, but they submit no specification, and neither the motors nor the cars offered are in use in this country, and we have not been able to obtain any definite information with regard to them. We, therefore, beg to recommend the acceptance of the Westinghouse Company's tender, subject to the suggested conditions with regard to the trolleys. We further recommend the selection of the Brill truck, and that 30 of the cars be fitted with chilled iron wheels, and we suggest that the car bodies be divided amongst the different makes offered, in the proportion of Brush 30, Milnes 10, and Brill 5.

The accepted tender is at £522 10s. for Brush bodies, £536 for Milnes bodies, £586 for Brill bodies, the motors in all cases being made by the Westinghouse Company.

Double deck trail cars for 52 passengers (20 cars required).—There appears to be nothing to choose between the designs of the lower-priced cars offered. If Messrs. Siemens Bros. do not object to supply trail cars without motor cars, we beg to recommend that their tender be accepted for 10 by the Electric Railway Carriage Company, and 10 by Messrs. Milnes & Co. Failing this arrangement, we recommend that the Westinghouse Company's tender be accepted for 20 Milnes cars.

Siemens Brothers' tender was at £155 for cars built by the Electric Railway Company, and £210 for Milnes' cars. The Westinghouse Company's tender was at £215.

Open trail cars (five required).—None of the designs offered seem to meet the requirements very well, and we recommend that the consideration of these tenders be deferred.

Sprinkling cars (two required).—The Westinghouse Company's tender (£336 per car) is the lowest, and we recommend its acceptance, subject to such alterations as we may require being made in the details.

Traversing platforms.—It is uncertain whether these will actually be required, and we, therefore, recommend that the consideration of these tenders be deferred.

Overhead travelling crane.—Messrs. Parsons & Sons provide girders of insufficient strength, and Messrs. Carrick's lower tender provides for rolled girders which are not suitable for the work. Messrs. Carrick's higher tender (£228) provides for a crane superior to that offered by Mr. J. Hitchen, and we beg to recommend the acceptance of their tender.

On the same minutes was a recommendation from the engineers for the provision of three spare ways for underground cables on the Anlaby Road, the cost for the power station being about £400.

The minutes were adopted and the tenders accepted at the same time.

Hungary.—According to recently published statistics, the total length of street railways at work in Hungary was, at the end of 1897, 187·5 kilometres (116 miles); and of this total 103·8 kilometres (64 miles) were worked by electric power. The latter total was distributed over eight lines; the Buda-Pesth street railway had 46·6 kilometres; the Buda-Pesth electric city railway, 26·2 kilometres; the Franz-Joseph underground line, 3·7 kilometres; the Buda-Pesth-Neupesth-Rakospalota electric street lines, 12·7 kilometres; the electric street railways of the environs of Buda-Pesth, 3·5 kilometres; the Miskolcz electric street line, 3·5 kilometres; the Maria-Theresiopel electric line, 3·2 kilometres. The lines, taken in the same order, have carried the following numbers of passengers:—27,449,125, 19,685,396, 3,575,657, 2,625,148, 262,707, 326,629, 604,938, 102,389, and, besides, three of the lines have carried a considerable amount of goods traffic. In the past year electric traction has been introduced on all the lines of Buda-Pesth, and two new lines have been opened. The yearly receipts per kilometre showed very considerable variations. The receipts of the Buda-Pesth electric city railway fell off 23 per cent. the year after the exhibition. —*Zeit. f. Elek.*

Italy.—A company has just been formed in Turin to construct and work an electric tramway between Varallo and Alagna. The water-power of the Otro Falls near Alagna is to be utilised.

Leamington.—The General Purposes Committee of Leamington Town Council have at present before them the proposal to establish a service of electric tramcars between Warwick and Leamington, in lieu of the present horse traction. The Committee have appointed a sub-committee to confer with the Warwick Council on the subject. The present company has still about three years to run.

Liverpool.—Last week the City Council resolved that the Tramways Committee be authorised to carry out the construction of a double line of electric traction from the Dingle to Aigburth Vale with the overhead trolley system at a cost of not exceeding £25,000. Mr. Lloyd seconded the motion. Mr. Fletcher hoped the mistake would not be made this time of increasing the original estimate by about 50 per cent. Captain Denton moved an amendment to the effect that three private firms be asked to tender for the work. Sir Thomas Hughes pointed out that the increase in the cost of the Dingle experimental line was due to two things which were not in the original estimate. They had now got a staff who had done honest, efficient, and economical work on the experimental line, and they ought to utilise their services and experience in laying down the continuation line to Aigburth Vale. Mr. Rutherford pointed out that a very much thicker wire had been used in the experimental line than was necessary, with the result of a corresponding increase in the thickness and clumsiness of the posts. This would be avoided in the continuation line, which would be lighter, more graceful and artistic. The recommendation was adopted unanimously. Mr. William Oulton, as chairman, moved the recommendation of the Tramways Committee that the committee be authorised to take steps to have plans, sections, and estimates prepared to continue the overhead electric traction tramways from the termination of the experimental electric line near Prince's Park gates also Croxteth Road to its intersection by Lodge Lane. This was carried.

London United Tramways.—At the monthly meeting of the Middlesex County Council the Highways Committee announced that the London United Tramways Company had submitted drawings showing the proposed construction of the tramways in Kew Bridge Road and High Street, Halfacre, and Boston Lane, Brentford; the main road from Brentford to Hounslow in Heston and Isleworth; and in Boston Lane and Lower Boston Lane in Hanwell. The company had also submitted plans showing the positions of the poles for the overhead wires in the Acton District. On the recommendation of the Committee, the County Council approved the action of the Committee in conditionally sanctioning the plans and drawings. It was also decided to authorise the Committee to deal with any further plans presented by the company.

Manchester.—Plans for a new electric underground circular railway in Manchester are in course of preparation, but there is a difference of opinion as to whether they will be ready in time for the approaching Parliamentary Session. Some people are also hoping for a zone system of electric trams—five miles a penny. At the last meeting of the Manchester City Council, the Electricity Committee were granted permission to execute certain classes of work without advertising for tenders. Councillor Maben (I. L. member), whilst not opposing the Committee's request, pointed out that many contracts had been entered into by the Gas Committee, which ought to have been advertised for in the usual way, and expressed a hope that that would not occur again in any department. Alderman Lloyd Higginbottom assured the Council that in every case where it would be inimical to the Corporation's interests, tenders would be advertised for. There were special works, however, where it would be highly undesirable.

Marseilles.—Our new contemporary, *Sell's Commercial Intelligence*, says that the tramway company at Marseilles are about to adopt electricity for tramway propulsion, instead of horses. The contract has been taken in hand by the Cie Alsacienne de Constructions, of Paris, and all the lines are to be finished in December, 1900.

Oldham.—Last week the Council held a special meeting to consider the expediency of promoting in the next session of Parliament a Bill for the purpose of authorising the Corporation to work tramways for the time being belonging to them, and by agreement with the Urban District Councils of Royton, Crompton, and Lees tramways, for the time being, belonging to those Councils respectively. It is proposed to work the tramways within and beyond the borough by electricity. Alderman Eckersley, the chairman of the Surveyor's Committee, said the total length of the proposed tramways was nine miles, or a total of twelve miles taken as a single line, including all passing places. The approximate total cost for the twelve miles, including concrete foundation, rolled steel girder rails, and fencing the track, was £5,000 per mile, or a total cost of £60,000. This amount, he stated, did not include the electrical equipment of the tramways. The whole of the new line would be laid on the girder rail principle, 4 feet 8½ inches gauge, each 6 inches in thickness, made of the very best quality of rolled steel, and weighing not less than 100 lbs. per yard. The steepest gradient would be in Middleton Road, and would be 1 foot in 11½ feet for a distance of 170 yards; and the sharpest curve would have a radius of 50 feet. The generating station was centrally situated, and could be enlarged at any time to work the whole of the tramway scheme, existing and proposed, in addition to the lighting of the borough. The Council granted the required sanction.

Scarborough.—The Electric Tramways Sub-Committee has considered a proposal made by a company to establish electric trams in the borough, and has recommended that the matter be deferred until the Committee had considered the various modes of electric traction and the policy of introducing either of them into the borough.

South Shields.—The Town Council has referred it to a committee to consider the promotion of a Bill in Parliament with a view to empowering the Corporation to work the tramways.

Southampton.—The Town Council had a lengthy debate on the question of electric traction last week, it being opened by a member moving that the resolution of the Council adopting the overhead trolley system for the borough be rescinded. The mover was partly influenced to take this step by an article in the *Pall Mall Gazette* on the Willesden experimental surface contact system. He asked for the subject of electric traction to be deferred for 12 months so as to give the Tramways Committee time to go thoroughly into the question. The resolution was not passed, but an amendment that no expense on electric traction in any form be incurred until the Tramways Committee bring forward a complete scheme to the Council.

Tees-Side.—The South Bank Urban Council last week considered the proposed application of the Imperial Tramways Company for powers to extend their electric tramway through South Bank, and resolved that, in their opinion, the scheme would be incomplete unless a line were extended from Normanby down the South Bank Road, so as to provide for the future development of the Council's district.

The Twickenham-Hounslow Light Railway Scheme.—The proposals of the Drake & Gorham Electric Power and Traction Company, Limited, as notified to the Twickenham and the Heston-Isleworth District Councils have, during the last week, arrived at a more mature stage. The result of a conference between the engineer to the promoters and the Highways Committee of the Twickenham District Council has been an amicable determination of the route to be taken through the parish of Twickenham. It differs slightly from that originally mapped out by the company. It will start at the Middlesex foot of Richmond Bridge, and will follow the main Hampton Court road, passing through part of the rising suburb of St. Margaret's-on-Thames, and thence to Twickenham, along the new street which is being constructed, into the London road, where it will turn northward, pass close to the Twickenham (S.W.R.) railway station, and away through Whitton, past the Royal Military School of Music at Kneller Hall. There it will meet the boundary of the Heston-Isleworth authority's jurisdiction, and the tentative route, subject to conference with the Works Committee of the Council, will

be past Hounslow Station, and northward again to the finish of the London United Tramway Company's authorised electric tramway, which it will cross, and take the Bath Road to the Hounslow Military Barracks, which, for the present, will be the terminus. The whole route will pass, except just about Whitton, through a rapidly developing area. Near Richmond Bridge the Cambridge Park Estate is being covered with houses and well arranged shops. The North End House Estate at Twickenham, contiguous to the proposed line, is also being largely built over, and near Twickenham Station the Perryn House Estate roads are completed and only await buildings, whilst opposite it the Cole Park Estate is being filled with houses of high value. The whole of these lands absolutely abut on the suggested railway, and at Hounslow, at the Whitton Park Estate, has been given over to the builders. On the Bath Road the improvement in the Bulshode Estate has been in the last two years very marked. Furthermore, the line, when constructed, will afford what does not exist, a rapid and cheap means of communication between Hounslow and Twickenham and Richmond. The company are prepared to lay out between £30,000 and £40,000 on the undertaking, and to give the District Councils the power of purchase at the end of a term of years. Locally, the proposal has been well received. The Highways Committee of the Twickenham District Council have expressed themselves very favourably towards it, and a petition to the Council to sanction the arrangement, in the belief that it will be for the good of the district, is being extensively signed by residents along the route, and the principal personages in the locality. The Drake & Gorham Company, however, will not be left in sole possession of the field, for the London United Tramways Company have notified to the Twickenham District Council that they shall apply for powers to construct a light electric railway in that district. They have not yet formulated their line of route.

Waterloo.—According to the minutes of the Tramways Committee the Council has been in negotiation with the directors of the Liverpool Overhead Railway Company with a view to them running an electric tramway from Seaforth to Great Crosby. The company were prepared to work the tramways subject to certain terms, which had been submitted to the Waterloo Council, and after considering the company's proposals it was resolved to draw up certain terms as the basis of an agreement with the company in connection with the construction, maintenance, and working of the tramways in the district. These terms were before the Council last week, and Dr. German in moving the adoption of the basis of the agreement, said it had been found from reliable estimates that the Council could not possibly conduct and work their own tramways without facing a loss for several years amounting to hundreds of pounds, and probably more, per annum. It was therefore decided to approach the Overhead Railway Company, as they were the most suitable body for supplying the power necessary to drive the tramcars. The company had already to provide enormous supplies for their own railway, and they could produce it much cheaper than other competing bodies; while the tramways would act as a great feeder to their own line. The recommendation was carried *nem con.*

Wolverhampton.—A deputation of the Wolverhampton Corporation Tramways Committee very recently visited Glasgow, Bradford, Leeds, and Halifax in order to see in operation tramways under varying conditions where gauges of 4 feet 8½ inches, 4 feet, and 3 feet 6 inches respectively have been adopted. They reported the result of their visit to a special meeting of the Town Council on Friday last, and they state that they are now convinced it is desirable to adopt a 3 feet 6 inches gauge instead of a 4 feet 8½ inches upon the tramways about to be acquired, when such tramways are ultimately worked by the Corporation, or leased to others. The deputation state that they have been further impressed with the desirability of constructing double lines on other roads than those mentioned in the previous report of the Tramways Committee. In accordance with the terms of the report of the deputation, the committee formally submitted to the Council recommendations for the alteration of the gauge of a double line of tramways where the width of the streets will permit. The adoption of the committee's recommendations was moved by the chairman of the Tramways Committee (Alderman C. T. Mander), and seconded by Alderman S. Craddock. A long discussion followed. The Council, however, gave the necessary consent to the proposed alterations.

TELEGRAPH AND TELEPHONE NOTES.

Edinburgh Telephones.—The Town Council has remitted to the Lord Provost's Committee to consider whether a municipal telephone license shall be applied for, and to go into the question of Parliamentary powers.

Municipal Telephone Licenses.—The Telephone Users' Association, Norwich, has been writing to the daily press on the subject of municipal telephone licenses as follows:—"It is evident, from the fact that licenses have been granted to Glasgow and Huddersfield, that the Government does not intend to take over the telephones, but to grant licenses to municipalities or to companies under their control, in accordance with the terms of the Treasury minute of May, 1892. This will entail upon every corporation anxious to have the control of the telephone exchange the trouble and inconvenience of obtaining a special Act of Parliament for its own particular locality. What is wanted now is pressure to be brought upon the Government to bring in a general enabling Act, whereby municipalities will be able to immediately take up the telephone business and work it in suitable areas, the extent of which ought to be at once under the consideration of every municipal authority. The chief point that requires the consideration of each town is what extent of area suits the surrounding neighbourhood."

The Postmaster-General and the Telephone Service.—A deputation from the Manchester Corporation, consisting of Mr. Southern, chairman of the Telephones Committee, Mr. Copeland, Mr. Brocklehurst, members of the committee, and Mr. Talbot, the town clerk, waited upon the Postmaster-General at St. Martin's-le-Grand, yesterday, in reference to the attitude of the department to competitive telephony. The Duke of Norfolk was accompanied by Sir Spencer Walpole, secretary to the Post Office. Mr. Southern explained that the Corporation were very anxious for competition in the matter of the telephone service in Manchester. They did not care very much whether that proceeded from another private company, from the Post Office, or in the last resort, from the municipality itself. All they were anxious about was that there should be some competition. A new telephone company had been floated in Manchester with a subscribed capital of £80,000, and this had received the statutory approval of the Corporation. In the absence of any definite undertaking from the Post Office that competitive exchanges would be set up by the department, the Corporation asked that the application of the New Mutual Company of Manchester for a license to compete with the National Telephone Company should be acceded to. It was pointed out, says the *Times* report, that the application was supported by a number of surrounding boroughs and local authorities. The Duke of Norfolk, in reply, stated that under no circumstances whatever would the department grant a license to the New Mutual Company or to any other new company. That might be taken as final. In answer to other questions addressed to him by the deputation, his Grace said he could give no definite information as to whether the Post Office itself would erect an efficient exchange within the Manchester area. The department would not grant an extension of any license beyond the year 1911—the period fixed for the determination of the license of the National Telephone Company. In the event of the Manchester Corporation setting up an exchange, he could give no promise that in 1911 the Post Office would purchase it at a fair valuation, but he suggested that if they came for a Bill for the purpose, Parliament would see that the municipality was not compelled to suffer any injustice. He could not say whether the Post Office proposed to bring in next session a general Bill empowering municipalities to create telephone exchanges under the provisional order system. The point had not yet been discussed, so that he could not say what the Government would do. The Government would consider the report of Mr. Hanbury's Select Committee on Telephones, and would, no doubt, bring forward such legislation as they deemed fit to give effect to its recommendations. Until the Government had come to a decision it would be out of place for him to say anything further.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
West Indies—		
St. Lucia-St. Vincent ..	Sept. 24th, 1898 ...	...
Amazon Company's cable—		
Cable beyond Gurupa ...	June 8th, 1898 ...	..
Bolama-Bissao	June 21st, 1898 ...	...
Gibraltar-Tanger	Oct. 8th, 1898 ...	...
Pernambuco-Ceara	Oct. 19th, 1898. ...	...
Saint Louis-Novonha ..	Oct. 17th, 1898 ...	...
Landlines.		
Majunga-Tananarive ...	Oct. 28th, 1898. ...	Oct. 31st, 1898.
Saigon-Bangkok	Oct. 31st, 1898 ...	...

CONTRACTS OPEN AND CLOSED.

OPEN.

Barrow-in-Furness.—November 14th. The Corporation invite tenders for the supply and erection of cast-iron lamp columns, arc and incandescent lamps, automatic switches and fittings. Messrs. Kincaid, Waller & Manville, consulting engineers. See our "Official Notices" October 28th.

Belfast.—November 14th. The Harbour Commissioners want tenders for the supply of nine iron lattice-built electric light masts, 70 feet high from the ground with suitable base. Mr. W. A. Currie, secretary, Harbour Office, Belfast.

Edinburgh.—November 14th. The Council want tenders for the supply of marine boilers and mechanical stokers and engines and dynamos for the electric light station in McDonald Road. Consulting engineer, Prof. A. B. W. Kennedy, 17, Victoria Street, S.W., at whose office specifications and drawings may be seen. See our "Official Notices" October 28th.

France.—November 8th. Tenders are being invited until November 8th by the French Post and Telegraph Authorities in Paris for the supply of four lots of telephone cable, and until November 10th for 46 kilometres of gutta-percha insulated electric cable and 50 kilometres of paper insulated cable. Tenders are to be sent to Le Sous-secrétariat d'Etat des Postes et des Télégraphes, Rue de Grenelle, 103, Paris, whence particulars may be obtained.

Glasgow.—November 22nd. The Corporation is inviting tenders for the supply and erection of switchboards and instruments for the new electricity works at Port Dundas. Specifications, &c., from Mr. W. A. Chamen, electrical engineer, 75, Waterloo Street, Glasgow. See our "Official Notices" this week.

Hanley.—November 14th. The Corporation is inviting tenders for the erection of a refuse destructor. Particulars from Mr. J. Lobley, borough engineer.

Harrogate.—The Corporation wants tenders for the supply of 18 cast-iron arc lamp poles, 18 feet long above ground, fitted with Hyde Park carriers. Borough electrical engineer, Mr. Geo. Wilkinson. See our "Official Notices" October 21st for particulars.

Hornsey.—November 7th. The Urban District Council is inviting tenders for the supply and erection of electric lighting plant for its Central Public Library in Tottenham Lane, Hornsey. Particulars, &c., from the Council's engineer, Mr. E. J. Lovegrove. See our "Official Notices" October 28th.

Hill of Howth.—November 19th. The Great Northern Railway Company (Ireland) is inviting tenders for the following in connection with their power station to be erected at Sutton, near Dublin, viz:—Lancashire boilers, with or without mechanical stokers, engines, dynamos, pumps, piping, crane, feed heater, and tools; switchboard. Specifications to be seen at the office of Prof. A. B. W. Kennedy, 17, Victoria Street, S.W. See our "Official Notices" this week for further details.

India.—November 23rd. The East Indian Railway Company is desirous of introducing electrically-controlled block instruments on their system, and invites proposals from makers only for the supply of: For single line—18 instruments for nine blocks; for double line—80 instruments for 41 stations, and six spare instruments. Particulars from Mr. A. P. Dunstan, secretary, Nicholas Lane, London, E.C.

Kilmalcolm.—Tenders are being invited according to an exchange, for apparatus for domestic lighting by either oil, gas, acetylene, or electric light, with dynamo and oil engine, at the Sailors' Orphan Homes. Further particulars from Messrs. H. & D. Barclay, 245, St. Vincent Street, Glasgow.

Manchester.—November 8th. The Corporation is inviting estimates for the laying of an extension of the system of underground telephone pipes, with other appurtenant works. For all particulars and drawings apply at the City Surveyor's Office, Town Hall, Manchester.

Middlesbrough.—November 29th. The Electric Lighting Committee is inviting tenders for the supply and erection of Lancashire boilers, and boiler house plant, slow speed steam dynamos and accessories, condensing plant and pipe work, overhead travelling crane, switchboard and instruments, accumulators, supply and laying of cables, meters. Specifications, &c., from the consulting engineer, Mr. Robert Hammond, 64, Victoria Street. See our "Official Notices" October 28th for further particulars.

Redditch.—The Urban District Council is wanting proposals from firms of contractors who would undertake the wiring of consumers' premises on a hire purchase or deferred payment system. See our "Official Notices" October 28th for further particulars.

Roumania.—November 8th. The General Direction of the Roumanian Posts and and Telegraphs in Bucharest is inviting tenders until November 8th for the supply of 60 tons of galvanised steel wire, 2 mm. diameter, and 16,000 small porcelain insulators.

Shanghai.—The Shanghai Municipal Council invites tenders for a concession for constructing and working about 23 miles of electric tramways on the trolley system in the streets of Shanghai. Plans may be seen and particulars obtained on application to Messrs. John Pook & Co., 8, Jeffreys Square, St. Mary Axe, London, E.C.

South African Republic.—November 12th. Tenders are being invited until the 12th inst. by the Consul-General of the South African Republic, in Amsterdam, for the supply of a quantity of porcelain insulators. Tenders are to be sent to Le Consul-Général de la République, Sud-Africaine, Nicolaas Witsenkaade, 9, Amsterdam. Particulars may be obtained for 1s. from M. F. J. Belinfante, 17, Paveljoensgracht, the Hague.

Southampton.—November 16th. The Committee of Visitors of the County Lunatic Asylum, Knowle, near Fareham, is inviting tenders for the supply of two engines and dynamos equal to an output of 24,000 watts each, together with all necessary washing machinery, lathe, drill, motors, lamp installations, &c., required in connection with the centralisation and increase of the light, heat, and power generating plant. See our "Official Notices" October 7th re specifications, plans, &c.

Spain.—November 8th. The Spanish Post and Telegraph Authorities in Madrid are inviting tenders until November 8th for the concession to establish and work a telephone exchange in the town of Cuenca. Particulars may be obtained from, and tenders to be sent to, La Direccion-General de Correos y Telegrafos, Madrid.

Toronto (Canada).—November 9th. The Toronto Board of Control is, according to *Daily Tenders and Contracts*, inviting tenders for a complete installation of electric lighting plant. Tenders will also be received for the various portions of the work, viz.: 1. Engine equipment. 2. Countershafts and pulleys. 3. Belting. 4. Boilers. 5. Feed pumps and condensers. 6. Water and steam piping. 7. Economisers. 8. Dynamos and station electrical apparatus. 9. Arc lamps. 10. Mast arms and lamp attachments. 11. Poles and overhead circuits. 12. Conduits and cables. Plans and specifications seen, and forms of tender obtained, at the office of the City Engineer, Toronto. The specifications for items Nos. 2, 3, 5, 6, and 7 may be withheld until the remainder of the apparatus is decided upon. A deposit in the form of a marked cheque, payable to the order of the City Treasurer, to the amount of 2½ per cent. of the value of the work tendered upon, must accompany each tender. Tenders, bearing the *bonâ fide* signatures of the contractor and his sureties, to the Chairman of the Board of Control, City Hall, Toronto, Canada, by noon on November 9th.

Wimbledon.—November 7th. The District Council is inviting tenders for the supply, delivery, and erection of transformers and accessories. Specifications, &c., from Mr. A. H. Preece, 39, Victoria Street, S.W. See our "Official Notices" October 14th.

CLOSED.

Burnley.—The Electric Lighting Committee has given the order for mechanical stoker for the electricity works to Messrs. Leach's, Limited, at £50. The contract for steam piping has been placed with the Burnley Ironworks Company.

Dewsbury.—The Corporation has given an order to Messrs. Callender's Cable Company for cable amounting to £1,396.

Edmonton.—The Board of Guardians has accepted the tender of Messrs. Thomas Medcalf & Co., Limited, of Bradford, to fit up the necessary installation to supply their institution with the electric light. The amount of the tender was £2,460.

Hull.—Upon Mr. Barnard's recommendation the Electric Lighting Committee has accepted the tenders of Messrs. T. Parker, Ltd., and Messrs. W. H. Allen, Sons & Co., for the supply of a second dynamo and engine at £1,900 and £2,150 respectively. This plant is to provide for future extensions, as it is thought that before next winter the plant will be too small to meet the demand. The various other plant and apparatus will not be ordered until after Christmas. The Local Government Board is to be asked to sanction a £16,000 loan for these extensions.

Hull.—The rolling stock and other tenders proposed for acceptance in connection with the Corporation tramways are stated in our "Traction Notes."

Liverpool.—The City Council on October 27th confirmed the acceptance by the Technical Instruction Committee of the tender of the Walsall Electrical Company, Limited, Liverpool, for supplying and fixing complete, one 36-inch electric fan, with necessary chamber and galvanised shafting, at the Everton Centre, St. Domingo Road, for the sum of £56 10s., subject to their undertaking to keep the same in efficient working order and repair for a period of 12 months.

FORTHCOMING EVENTS.

Tuesday, November 8th.—Paper on "The Extraction of Nickel," by Prof. W. C. Roberts-Austen, C.B., F.R.S., Assoc. Inst.C.E.

Thursday, November 10th.—Institution of Electrical Engineers. Opening meeting for the session. Paper by Prof. S. P. Thompson on "Rotatory Transformers."

Friday, November 11th.—At 5 p.m. Physical Society. At the rooms of the Chemical Society, Burlington House. Agenda: (1) Discussion on Mr. A. Campbell's paper on "The Magnetic Fluxes in Meters and other Electrical Instruments," to be opened by Prof. W. E. Ayrton, F.R.S.; (2) "On the Propagation of Damped Electrical Oscillations along Parallel Wires," by Prof. W. B. Morton, M.A.; (3) "On the Properties of Liquid Mixtures," by R. A. Lehfeldt.

Saturday, November 12th.—At 3 p.m. The Institution of Junior Engineers' visit to the King William Street station of the City and South London Railway extension works.

Wednesday, December 7th.—Institution of Electrical Engineers. Annual Dinner, Grand Hall, Hotel Cecil.

NOTES.

Electrical Water Level Recorders.—Before the Bristol Association of Engineers last Saturday, Mr. J. A. McPherson, A.M.I.C.E., read a paper on "Notes upon Regulating and Recording Apparatus for Reservoirs, Gauge Weirs, and the Flow of Water." The method of electrically recording the level of water in reservoirs or tidal basins was first dealt with. Diagrams were shown illustrating the mechanical and electrical action of the apparatus.

Electrical Power Transmission.—Replying to a rather over-cautious article in the *Engineer* on "Electrical Transmission," Mr. Hart, of the De Laval Separator Works, of Poughkeepsie, tells how he had a rapidly extending works to deal with, in which a number of lay shafts, extending in length each 150 feet, and 20 feet apart. He was obliged to put in electrical transmission, as the work became too great for his power, and this was done by laying down a boiler and two dynamos, one being driven by the spare engine. One shaft after another was thrown upon the new system, and finally, with the same engine and electrical transmission, much more work was being done, as regards machinery driven, than was formerly the case, and several motors were 400 feet away from the engine. It was found very easy to add one motor after another. Moreover, the old system of shafts was still preserved. The difference was merely in the driving of the many parallel shafts on which the machines may be said to have been grouped. Another letter comes from Wakefield, where Messrs Green & Son's works have been changed during the past two years to electrical driving. The writer, however, is so hopelessly involved and mixed in style and figures, that it is impossible to pick out anything from the letter.

The End of a Failure.—The Engineering and General Contract Company appears to be in a poor state. It was started as the Hopcraft Furnace Company in 1889, and was hugely advertised at a cost of about £10,000. The Hopcraft furnace was a mistaken idea from the first, though the company was floated on the results of a furnace on a penny Thames steamboat — the *Violet*, we believe. Furnaces were sent to Sweden and to Germany, and were failures. One was tried at Bradford, and one of the company's engineers wrote to the directors and warned them that the furnace was "absolutely useless as a steam generator." It was reported at the outset that the capital was over-subscribed, but we believe this was untrue. The public were asked for £220,000, and the company went to allotment on £190,000, and, so far as we can learn, applicants were allotted in full. The pitiable part of the whole business was that if there had been a genuine attempt to ascertain its merits before appealing to the public, any engineer who knows a furnace could have told the directors that it was a hopeless idea from the first. A correspondent of the *Pall Mall Gazette* thinks that shareholders should investigate the whole history of the company from the beginning.

Water-Power in Switzerland in 1897.—Our French contemporary *L'Electricien* has recently published some figures upon this subject, and below we give a summary of the more important ones appearing in that paper. During 1897, 35 new projects received the sanction of the authorities, and five extensions of existing installations were also approved. Of the 35 new schemes, 17 were lighting schemes, four were transmission schemes, and 14 were combined lighting and transmission schemes. Continuous current was to be used for 14 lighting installations, one transmission scheme, and seven of the combined lighting and transmission plants. The triphase system was to be used in connection with the remaining 13 schemes. Most of the schemes were small, and support the statement that shortly every little village in Switzerland will be lighted and supplied with power for its smaller industries by electricity developed from water-power in the vicinity. The total power of the 35 new schemes is made up as follows:—

		Kilowatts.
27 installations under 100 kw.		925
6 „ 100—500 kw.		1,324
2 „ over 500 kw.		2,740
Total		4,989

This total is 1,758 kw. less than that of the preceding year. The decrease is explained by the fact that all the larger and more easily developed waterfalls have already been exploited.

Personal.—We understand that Lord Kelvin has accepted a seat on the board of the Linotype Company, Limited, in succession to the late Dr. John Hopkinson, F.R.S.

Constitution and Resistance of Mercury.—At the recent Congress held by *La Société Allemande d'Electrochimie* at Leipzig, a paper was communicated by M. Liebenow with regard to the constitution of mercury. From his experiments it appears that the electrical resistance of the alloys depends principally upon the molecular grouping, *i.e.*, upon the number of atoms forming the molecule of the solid substance. In the case of solid mercury the molecular grouping is extremely complex, but in the gaseous condition it is probably monoatomic. It is remarkable that, whereas for most pure metals, including solid mercury, the temperature coefficient for resistance is in the neighbourhood of 0·004 per 1° C., whilst for liquid mercury the coefficient is only 0 001. Liquid mercury appears to be a mixture of monoatomic molecules, and the more complex groupings characteristic of the solid condition.

The Chair of Electrical Engineering at the McGill University.—A Canadian exchange gives some biographical notes of Prof. R. B. Owens, who has been appointed successor to Prof. Carus-Wilson in the W. C. McDonald chair of electrical engineering at McGill University, Montreal. Prof. Owens, who is a comparatively young man, was selected from among the teaching staff of the great universities of the United States. He was at one time connected with the old Baxter Motor Company, but subsequently resumed study under Dr. Louis Duncan at John Hopkins University, Baltimore, and obtained a high standing in mathematics and physics. In 1891 he studied under Prof. Crocker at the Columbia University, and obtained the degree of E E. Nebraska University is indebted to him for some excellent organisation work. He was, in 1894, Professor of Electrical Engineering there, and in 1895 he took full charge of the Department of Electrical and Steam Engineering. He was one of the judges of electrical exhibits at the World's Fair. He was recently elected to a Tyndall Fellowship by Columbia University, is a member of a number of American engineering societies, and vice-president of the American Institute of Electrical Engineers.

The Thompson-Walker Surface Contact Tramway.—We are informed by Prof. S. P. Thompson that our article on the "Supersession of the Trolley," in which we represented him as putting his surface contact system forward as superseding overhead lines does not actually represent his views, and that by an oversight the quotation which we attributed to him was not accurately given. To be strictly accurate it should have been, "London has done well to wait for something better than the overhead trolley wire. But the slot conduit is not the *only* alternative, nor the best alternative"; the word "*only*" having been omitted. If we have misrepresented Prof. Thompson's views, we certainly regret in any way having done so, but it is not a little curious that the *Pall Mall Gazette*, of October 15th (nearly a week before our article appeared), should have fallen into the same error, and entitled its article "Electric Tramways—the Overhead System Superseded."

Enclosed Arc Lamp Patents.—We are informed that a writ was served by the Jandus Arc Lamp and Electric Company on Messrs. Beanland & Perkins a short time back in connection with the "Ajax" arc lamp, and probably the result of the first trial will soon be known. The final decision may not, however, be reached for a considerable period, as the issue at stake will possibly be considered sufficient to carry the matter to the House of Lords. It is not the intention of the company to grant any further license under the patents controlled by them after the case has come into Court.

Lectures.—Before the South African Association of Engineers at Johannesburg a few weeks ago, Mr. J. R. Cowell, general manager of the Johannesburg Town Lighting Department, read a paper on "Electric Lighting Supply."

At a meeting of the Liverpool Polytechnic Society last week, Mr. R. H. Scotter, C.E., A.M.I.M.E., lectured on "Closed Conduit or Surface Contact Systems of Electric Traction."

Cost of Copper for Transmission Circuits.—In a paper recently read by Mr. Chas. F. Scott, electrical engineer of the Westinghouse Electric Manufacturing Company, and embodied in a paper on "Electricity in Paper Making," read before the American Paper and Pulp Association, gave his conclusions as to the efficiency of electrical apparatus in the following words:—"The full load efficiency of generators, both of direct current and alternating current, varies with the size and type, but for machines of 100 horse-power and over the variation may be from 90 or 91 per cent. to 95 or 96 per cent. The efficiency of alternating current transformers, in the same way, may be said to vary from 96 or 97 per cent. in sizes less than 100 horse-power and 97 or 98 per cent. in larger sizes. The efficiency of motors both for direct current and alternating current varies from 80 or 85 per cent. to 90 per cent. in sizes from 5 to 100 horse-power, and is 90 per cent. to 96 per cent. for larger sizes. Efficiency of transmission lines and distributing circuits depends upon the E.M.F., the amount of copper and upon the cost. The approximate efficiency of a transmission plant will therefore be between limits about as follows:—

Generators	90 to 96 per cent.
Raising transformers ...	93 „ 98 „
Transmission line	90 „ 95 „
Lowering transformers... ...	96 „ 98 „
Local wiring	97 „ 99 „
Motors	85 „ 96 „
Efficiency of plant ...	61 to 83 per cent.

In local distribution from low voltage generators the losses in raising and lowering transformers are of course eliminated, and the range of efficiency becomes 66 per cent. to 86 per cent."

Comparison of the Rheostat and the Series Parallel Controller for Street Electric Car Service.—The following is an abstract from the *Electrical World* of a paper presented in August before the American Association for the Advancement of Science by Prof. Thomas Gray:—"In the spring of 1896 a number of experiments were made at Louisville, Ky., by members of the senior class of the Rose Polytechnic Institute on the relative efficiency of the above methods of controlling the current flowing through the motors of an electric car. In the rheostat method the motors were in parallel, and the total current was passed through a rheostat having a maximum resistance of 4·2 ohms. In the series parallel method the rheostat was first used with the motors in series, and after the resistance had been cut out the next step of the controller lever threw the motors in parallel, and at the same time put each in series with half the rheostat. After this the resistance was cut out, and the two motors left in parallel. The final conditions were thus the same in both cases. The tests included the measurement by means of an integrating wattmeter of the watt-hours required to make a round trip of 5·5 miles, the car being stopped 40 times during the trip. An autographic record was taken of the variation of current strength during the start. The rheostat method takes maximum current at the initial contact, after which there is gradual diminution as the car attains speed, combined with temporary sudden increments as the successive coils of the rheostat are cut out. The series parallel method gives the maximum current when the motors are first put in parallel, which is after the car has attained a speed of 4 or 5 miles per hour. The consequence is that more of the power is used for propelling the car, and less for overcoming ohmic resistance. There resulted thus a comparative economy of from 10 to 15 per cent. under the conditions of the test. The ratio of the electric power used in starting the car in the two cases, as indicated by the record, was approximately 4 to 5. The total weight of the car used was about 15,300 lbs., the watt-hours per car mile averaged about 900, and the maximum speed between stops about 12 miles per hour."

Munificence.—We understand that last week Sir David Salomons paid to the treasurer of the Urban District Council of Southborough, near Tunbridge Wells, the sum of £3,000 as a contribution to the cost of erecting a theatre in that place, as a memorial of the Diamond Jubilee. The total cost of the scheme is £6,000, the second moiety being contributed from the rates.

Proof of the Theory of the Solubility of Salts Consisting of Three Ions.—In the case of salts consisting of two ions, the influence of an admixed salt with one similar ion on the solubility has been proved to be in accord with the theory $k_1 \times k_2 = \text{constant}$, where k_1 and k_2 are the concentrations of the two ions. In the case of salts of three ions, a complete proof of the expression $k_1 \times k_2 = \text{constant}$ has not been obtained, and the authors therefore attempt to verify this equation by the determination of the solubility of lead iodide in water, and in very dilute solutions of potassium iodide and of lead nitrate. Owing to the extreme dilution, the salts are almost completely dissociated, so that dissociation changes do not occur to complicate the results. The solubility determinations were done by the conductivity method, which has the advantage of giving directly the number of ions. If m_0, a_0 are the solubility and dissociation of lead iodide in water, and m_1 a_1, m_2 a_2 the corresponding values for the lead iodide and potassium iodide in the mixed solution, then $m_1 a_1 (m_1 a_1 + m_2 a_2)^2 = m_0^2 a_0^3$ and as $m_2 a_2$ and $m_0 a_0$ are known, the values for $m_1 a_1$ are obtained by approximations. For the lead nitrate solutions the expression $(m_1 a_1 + m_2 a_2) m_1^2 a_1^2 = m_0^3 a_0^3$ holds, and the values for $m_1 a_1$ in this case may be similarly obtained. The calculated values agree very closely with the determinations, so that for lead iodide the solubility law stated is valid. The above is an abstract of a paper by Arthur A. Noyes and E. Harold Woodworth in the *Zeitschrift für Physikalische Chemie*, 1898, 25, 152—158.

Mercury Contacts.—We have recently come across some information regarding Cunynghame's cut-outs which some years ago were so extensively used by Messrs. Woodhouse & Rawson. These at the time behaved satisfactorily as far as making contact was concerned, and up to 100 volts they acted very well, but, of course, they only broke contact very occasionally. For higher voltages it was absolutely necessary to add a fine shunt wire which carried the current for that infinitesimal length of time necessary to let the movable part get clear of the mercury, so that it will be seen the use of a shunt circuit to the mercury for taking the spark is not a thing of recent date.

Presentation.—At the South Shields electric supply station last Saturday a presentation was made to Mr. J. S. Watson, the chief assistant electrical engineer, on the occasion of his leaving to take up an appointment with the Newcastle-on-Tyne Electric Supply Company. Mr. J. A. Jeckell made the presentation on behalf of the staff. The presents consisted of a kit dressing-case and a travelling rug.

Inventiveness of the Americans.—A French contemporary, *Cosmos*, publishes a table showing the number of patents granted in each country up to the end of 1897. According to this there have been over 1,729,000 patents issued, of which 606,423 were granted in the United States, showing that more than one-third of all the patents taken out were American.—New York *Electrical World*.

Electrical Engineers Volunteers.—We understand that the enrolment of men into the Electrical Engineers R.E. (Volunteers) corps begins again this month, and the headquarters, 13, Victoria Street, S.W., are open between 7 and 8 p.m. on Mondays and Thursdays. We should not be surprised to hear that the Fashoda affair has led to a rush for admission to this corps. Electrical engineers are a busy lot of men, but they are nothing if not patriotic.

Appointments.—The Liverpool City Council on Thursday last week, on the recommendation of the Tramways Committee, appointed Mr. Wm. Hy. Collis to be assistant engineer for the electric tramways at a salary of £240 per annum, and Mr. Miles Pattern was appointed motor inspector at £2 15s. a week.

Folkestone Electricity Supply Company.—This company's station was opened on Wednesday last with every prospect of success. We shall refer to it at length in another issue.

"**Electricity.**"—Our eight-year-old 1d. contemporary, published across the way, gives its readers a feast on the occasion of its birthday. In the annual birthday number—October 28th—the editor brings his readers into touch with some of our more prominent consulting electrical engineers, and gives illustrated descriptions of examples of their works. Mr. Robert Hammond appears in connection with the so successful Leeds electricity works, Prof. A. B. Kennedy as the consultant of the celebrated Edinburgh undertaking, Mr. H. F. Parshall with his latest electric tramway power plant and equipment at Middlesbrough, and Mr. E. Manville is placed in position with the Shoreditch combined lighting and refuse destructor plant. There are various other articles more or less interesting, including one by Mr. Robt. Hammond on the pioneer work of the Leeds central station. Forty pages of reading matter is a feast when that matter "compares favourably in quality with that offered" by "our more highly-priced contemporaries." We congratulate *Electricity* readers upon their yearly feast.

NEW COMPANIES REGISTERED.

Payne & Bates, Limited (59,325).—This company was registered on October 28th, with a capital of £7,000 in £1 shares, to acquire and take over as a going concern the business now carried on by Walter S. Payne and Henry Bates, at Great Heath, Foleshill, near Coventry, and elsewhere, as "Payne & Bates," and to carry on the business of engineers, manufactures of and dealers in gas, oil, steam, electric and other engines, motors, parts and accessories, &c. The subscribers (with one share each) are:—Walter S. Payne, 6, Rose Terrace, Station Street, Foleshill, engineer; Henry Bates, Great Heath, Foleshill, engineer; Mrs. Harriett Payne, 6, Rose Terrace, Station Street, Foleshill; Mrs. Henry Bates, Great Heath, Foleshill; George Bates, The Hollies, Great Heath, Foleshill, gentleman; Sylvester R. Masser, Stivichall, Coventry, solicitor; and Leonard J. L. Hughes, Elmcroft, Kenilworth, solicitor. The number of directors is not to be less than three nor more than seven; the first are George Bates, Walter S. Payne, and Henry Bates; qualification, 250 shares; remuneration as the company may decide.

Northallerton Electric Light and Power Company, Limited (59,301).—Registered on October 27th, with a capital of £2,000 in £1 shares, to carry on the business of electricians, electrical and mechanical engineers and contractors, suppliers of electricity, and electrical apparatus manufacturers. The first subscribers are:—John E. Hutton, Solberge, Northallerton, electrical engineer, 150 shares; William J. Plews, Northallerton, brewer, 10 shares; William A. Chauncey, Northallerton, major, 5 shares; Chas. E. L. Ringrose, Northallerton, registrar, 5 shares; Wm. G. Jackson, The Mount, Northallerton, schoolmaster, 5 shares; Wm. Baigent, M.D., Northallerton, 5 shares; Joseph A. Hutchinson, M.D., Northallerton, 5 shares; Henry B. Peirse, Bart., Bedale, 5 shares; Albert de L. Long, Northallerton, engineer, 10 shares. Table "A" mainly applies. Registered office, High Street, Northallerton, Yorks.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Porous Accumulator Company, Limited (57,526).—This company's statutory return was filed on September 28th, when the whole capital of £3,000 was taken up; 1,993 shares are considered as paid, and £1,007 has been received on the others.

CITY NOTES.

Monte Video Telephone Company.

The annual ordinary general meeting of this company was held on Monday, at Winchester House, E.C.

Mr. Herbert Ward presided, and in moving the adoption of the report and accounts said the past year's results showed an improvement in the business of the company. The subscribers had increased by 108 in number, and the two months subsequent to the date to which the accounts were made up showed a further increase of 32. The additional capital outlay for the year was £1,675, which was small having regard to the increase of subscribers. With reference to the rearrangement of the capital of the company, the Court confirmed the reduction of the ordinary share capital by £60,000 on October 19th. The board had anticipated that they might possibly have been able to recommend a dividend on the ordinary shares on this occasion as well as the preference, but that had not been the case, because in a measure that was dependent on the receipt by the board of the company's promissory notes, for which shares were to be delivered, or nearly all of them, and at the date of the report they had not received sufficient to warrant the recommendation of a dividend. However, the considerable amount carried forward added materially to the assurance of future dividends.

Mr. Frank W. Jones, who seconded the motion, said it was most important for the company to have a reserve, and it would be very useful to have the amount which might have been paid on the ordinary shares at the disposal of the board.

Mr. Locke urged the payment of a small dividend, say, 2½ per cent. on the ordinary shares, and proposed an amendment to that effect, but it was not seconded.

The report and accounts were adopted.

Venezuela Telephone and Electrical Appliances Company.

The report of the directors of the Venezuela Telephone and Electrical Appliances Company, Limited, for the year ended June 30th last, to be submitted at the general meeting to be held in London on Friday, states that the accounts show a profit of £9,942, to which must be added £744, being the balance brought forward from June 30th, 1897, after payment of dividends on the ordinary and preference shares. After providing for the interest on the first and second debentures, &c., and the dividend on the preference shares up to June 30th last, there remains a balance of £5,499, out of which the directors recommend a dividend on the ordinary shares for the year ended June 30th last at the rate of 4 per cent. per annum, which will absorb £2,800; that the balance of the discount and expenses of the first debenture issue, amounting to £1,500, should be written off; that £500 should be carried to reserve account, and that the balance of £699 be carried forward. The capital outlay for the year was £1,754, as against £8,423 during the previous financial year. The company's property has been fully maintained. On June 30th last the number of subscribers for the company's instruments was 2,640. During the period under review, commerce in Venezuela has experienced considerable difficulties. The fall in the price of coffee has seriously affected the profits of the growers, and trade has been further depressed by an outbreak of small-pox, which, in some districts, has been so serious, as almost to stop business. The directors are of opinion that the shareholders may be congratulated on the fact that even with these disadvantages, the company is able, after applying £2,000 out of revenue to capital purposes, to distribute the usual dividend of 4 per cent.

The Alderley and Wilmslow Electric Supply, Limited.

The statutory meeting of shareholders of this company was held at the registered offices of the company, Mr. W. P. J. Fawcus presiding. The circular convening the meeting was read by the secretary (Mr. W. E. Rowcliffe), who explained as to the progress made in the erection of the generating station which is being erected at Belmont. It was further stated that the contract for the electric cables has been placed with Edmundson's Electricity Corporation, Limited, and the work will be proceeded with forthwith, and consumers might therefore anticipate the supply of current in the early spring. Mr. Philip Whyman, of Alderley Edge, and Mr John Royle, of Wimslow, were unanimously elected directors.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending October 29th, 1898, were £262 3s. 10d.; aggregate to date, £12,943 8s. 5d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending October 28th, 1898, were £2,819 2s. 3d.; corresponding period, 1897, £2,570 12s. 7d.; increase, £248 9s. 8d.

The City and South London Railway Company.—The receipts for the week ending October 30th, 1898, were £1,000; week ending October 31st, 1897, £1,018; decrease, £18; total receipts for half-year, 1898, £17,277; corresponding period, 1897, £16,539; increase, £738. Miles open, 3½.

The Dover Corporation Electric Tramways.—The receipts for the week ending October 29th, 1898, were £190 9s. 5d.; week ending October 30th, 1897, £117 6s. 3d.; increase, £73 3s. 2d.; total receipts to October 29th, 1898, £7,174 19s. 1d.

The Dublin United Tramways Company.—The receipts for the week ending October 28th, 1898, were as follows:—D. U. T. Co., horse cars, £2,344 10s. 8d.; ditto, electric cars, £375 6s. 6d.; D. S. D. Co., electric cars, £823 6s. 9d.; total, £3,543 3s. 11d; corresponding week last year—D. U. T. Co., horse cars, £2,707 1s. 11d.; D. S. D. Co., electric cars, £482 8s. 9d.; total, £3,189 10s. 8d.; increase, £353 13s. 3d.; aggregate to date, £72,537 16s. 5d.; aggregate to date last year, £66,764 13s. 3d.; increase to date, £5,773 3s. 2d.; Worked:—The mileage open is 13 miles electrically, 31 miles by horses, as against 8 miles electrically, and 34 miles by horses, for the corresponding period last year.

The Liverpool Overhead Railway Company.—The receipts for the week ending October 30th, 1898, amounted to £1,407; corresponding week last year, £1,364; increase, £43.

The South Staffordshire Tramways Company.—The receipts for the week ending October 28th, 1898, were £664 10s. 6d.; week ending October 29th, 1897, £628 1s. 5d.; aggregate receipts for 42 weeks, £27,234 3s. 6d.; last year, £27,476 9s. 5d.

The Western and Brazilian Telegraph Company, Limited.—The receipts for the week ending October 28th, 1898, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £3,355.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1895.	1896.	1897.	Closing Quotation, Oct. 26th.	Closing Quotation, Nov. 2nd.	Business done during week ended Nov. 2nd. 1898. Highest.	Lowest.
127,400£	African Direct Telegraph, 4 % Debs.	100	4 %	...	...	100 —104	100 —104	103	...
25,000	Amazon Telegraph, shares	10	...	...	...	6 — 7	6 — 7	...	...
125,000	Do. do. 5 % Debs. Red.	100	...	...	...	92 — 95	92 — 95	...	...
905,560£	Anglo-American Telegraph	Stock	£2 9s	£2 13s	3 %	61 — 64	61 — 64	...	...
3,047,220£	Do. do. 6 % Pref.	Stock	£4 18s	£5 6s	6 %	111 —112	112 —113	113	112
3,047,220£	Do. do. Deferred	Stock	...	...	...	13⅜— 14¼	14¼— 14⅜	14 9/16	13 15/16
130,000	Brazilian Submarine Telegraph	10	7 %	7 %	7 %	15¾— 16¼	15½— 16	...	...
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	5 %	...	...	111 —115	111 —115	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	4 %	2⅜— 3¼	2⅜— 3¼	...	...
10,000,000$	Commercial Cable	$100	7 %	8 %	8 %	180 —190	180 —190	...	...
918,297£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	104 —106	104 —106	105¼	...
224,850	Consolidated Telephone Construction and Manufacturing	10/-	1½ %	2 %	...	1/16— 3/16	1/16— 3/16	...	...
16,000	Cuba Telegraph	10	8 %	8 %	7 %	8½— 9½	8½— 9½	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	15½— 16½	15½— 16½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 — 11	10 — 11	...	...
30,000£	Do. do. 4½ % Debs., Nos. 1 to 6,000	50	4½ %	4½ %	4½ %	104 —107%	104 —107%	...	...
60,710£	Direct United States Cable	20	2¼ %	2¼ %	...	11¼— 11⅜	11½— 12	11 1/16	11 7/16
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	101—104	101 —104	...	...
400,000	Eastern Telegraph, Nos. 1 to 400,000	10	6¼ %	6¼ %	7 %	17¼— 17⅜	17¼— 17⅜	17⅝	17½
1,295,000	Do. 3½ % Pref. Stock	100	...	...	...	104 —107	104 —107	104½	...
500,000	Do. Prov. Certs., 50 % paid	...	...	...	...	52 — 55	52 — 55	...	...
89,900	Do. 5 % Debs., repayable August, 1899	100	5 %	5 %	5 %	100 —103	100 —103	...	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	4 %	126 —130	124 —128 xd	125	...
250,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	17¼— 17⅜	17¼— 17⅜	17⅜	17⅜
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	5 %	100 —104	100 —104	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	5 %	101 —104	101 —104	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	125 —129	125 —129	...	...
35,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5 %	...	100 —104	100 —104	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	...	101 —104	101 —104	...	...
300,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	4 %	...	102 —105	102 —105	...	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	4 %	...	104 —107%	104 —107%	...	...
180,227	Globe Telegraph and Trust	10	4½ %	4½ %	4½ %	12 — 12½	12 — 12½xd	12⅜	12⅛
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	16¾— 17¼	16½— 17 xd	...	...
150,000	Great Northern Telegraph, of Copenhagen	10	10 %	10 %	10 %	28½— 29½	28½— 29½	28⅝	...
150,000£	Do. do. do. 5 % Debs.	100	5 %	5 %	5 %	100 —103	100 —103	...	...
97,800	Halifax & Bermuda Cable, 4½% 1st. Mt. Dbs., w'n. 1-1,200, rd.	100	...	...	...	101 —104	101 —104	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	52 — 55	52 —55 xd	54⅜	54
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	6 %	109 —112	109 —112	...	...
484,597	National Telephone, 1 to 484,597	5	5½ %	5½ %	6 %	5⅛— 5⅜	5⅛— 5⅜	5 5/16	5⅛
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	13⅜	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5⅛— 5⅜	5⅛— 5⅜	...	...
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	100—105	100 —105	...	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅜— ½	⅜— ½xd	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	105 —108	105 —108	...	...
11,839	Reuter's	8	5 %	5 %	5 %	7½— 8½	7½— 8½	..*	...
3,381	Submarine Cables Trust	Cert.	...	...	...	133 —138	133 —138	...	...
58,000	United River Plate Telephone	5	4 %	5 %	6 %	4¼— 4⅜	4¼— 4⅜	...	...
151,733£	Do. do. 5 % Debs.	Stock	5 %	...	...	103 —106	103 —106	...	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	5 %	5 %	99 —102	99 —102	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	⅛— ¼	⅛— ¼	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	104 —107	104 —107	...	...
64,269	Western and Brazilian Telegraph	15	3 %	2 %	3½ %	12¼— 12⅜	12¼— 12⅜	12⅝	...
33,129	Do. do. do. 5 % Pref. Ord.	7½	5 %	5 %	5 %	8 — 8½	8 — 8½	...	...
33,129	Do. do. do. Def. Ord.	7½	1 %	*nil*	½ %	4 — 4½	4 — 4½	4⅛	...
389,521	Do. do. do. 4 % Deb. Stock Red.	Stock	...	...	...	107 —110	107 —110	...	...
88,321	West India and Panama Telegraph	10	⅞ %	1 %	⅞ %	1⅛— 1⅜	1⅛— 1⅜	1 1/16	...
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	9¼— 9⅜	9¼— 9⅜	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	7 — 9	7 — 9	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	5 %	106 —109	106 —109	...	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds	100	6 %	6 %	6 %	98 —103	98 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electricity Supply	5	5 %	6 %	7 %	11½— 12½	11½— 12½	...	...
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6½	6 — 6½	...	...
34,000	*Chelsea Electricity Supply, Ord.,	5	5 %	5 %	6 %	8 — 9	8 — 9	...	...
60,000	Do. do. do. 4½ % Deb. Stock Red.	Stock	4½ %	4½ %	4½ %	113 —115	113 —115	...	...
50,000	City of London Electric Lighting, Ord. 40,001—90,000	10	5 %	7 %	10 %	23 — 24	23½— 24½	24⅛	23⅞
10,000	Do. Ord. Nos. 90,001 to 100,000	10	...	...	...	22½— 23½	23 — 24	...	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	15½— 16½	15½— 16½	16	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	127 — 132	127 —132	131	...
30,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—30,000	10	*nil*	*nil*	*nil*	12½— 13½	12½— 13½	13 1/16	...
10,000	Do. do. do. Nos. 30,001 to 40,000 £8 paid.	10	...	...	...	10 — 11	10 — 11	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	14½— 15½	14½— 15½	14⅝	14⅜
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400	5	...	...	5 %	5 — 5½	5 — 5½	...	...
15,661	House-to-House Electric Light Supply, Ord., 101 to 15,761	5	...	...	4 %	8½— 9½	9 — 10	9½	9⅜
12,000	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	9½— 10½	9½— 10½	...	...
110,000	London Electric Supply Corporation, Limited, Ord.	3	...	...	...	... ...	3½— 4	3 15/16	...
48,050	Do. do. do. 6 % Pref.	5	...	...	...	... ...	6— 6½	6½	...
62,400	*Metropolitan Electric Supply, 101 to 62,500	10	4 %	5 %	6 %	15 — 16	15½— 16½	16⅜	16
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½ %	4½ %	4½ %	117 —121	117 —121	...	...
6,452	Notting Hill Electric Lighting	10	2 %	4 %	6 %	15 — 16	15 — 16	15¼	...
31,980	*St. James's and Pall Mall Electric Light, Ltd.	5	7¼ %	10½ %	14½ %	15½— 16½	16 — 17	...	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10	...	...
50,000	Do. do. 4 % Deb. Stock Red.	Stock	...	...	4 %	104 —107	105 —108	107	105½
65,000	South London Electricity Supply, Ord., £3 paid	5	...	...	...	2⅞— 3⅛	2⅞— 3⅛	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000	5	7 %	9 %	12 %	14½— 15½	14½— 15½	15⅝	15

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1895.	1896.	1897.	Closing Quotation Oct. 26th.	Closing Quotation Nov. 2nd.	Business done during week ended Nov. 2nd, 1898. Highest.	Lowest
60,000	Aluminium "A" shares, Nos. 1—60,000	1	...	...	...	2⅞— 3⅛	2⅞— 3⅛	...	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	94 —100	94 —100	...	...
30,000	British Electric Traction	10	...	...	...	16 — 17	16½— 17½	17⅛	16⅞
10,000	Do. do. 6 % Cum. Pref. 30,001—40,000 (issued at £2 10s. prem. all pd.)	10	...	...	...	13 — 14	13 — 14	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	2½%	*nil*	*nil*	1⅝— 1⅞	1⅝— 1⅞	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	3 %	*nil*	4 %	2 — 2¼	2 — 2¼	2⅛	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	109 —113	109 —113	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	103 —106	102 —105	103½	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	...	...	...	10 — 11	9½— 10½xd	...	...
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	110 —113	110—113	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	9⅜— 10½	9⅜— 10½	10½	10
178,303	Do. do. do. £6 paid	10	...	...	...	5⅜— 6½	5⅜— 6½	...	...
61,033	Do. do. Pref. half-shares £1 paid ...	...	...	...	...	1¼— 1⅜	1¼— 1⅜	...	...
71,447	Do. do. Def. do. £5 paid ...	...	...	...	...	4½ 5	4½ 5	...	...
630,000*l*	City and South London Railway	Stock	1 3/16 %	1 0/16 %	1⅞ %	70 — 72	69 — 71	71¼	70
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 £3 pd.	10	...	...	...	2¾— 3¼	2¾— 3¼	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	1½— 2	1½— 2	...	...
82,850	Do. 5% 1st Mort. Reg. Debs., 1 to 743 of £100, and 901 to 1,070 of £50 Red.	...	...	...	...	91 — 96	91 — 96	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5 %	5½%	6 %	2¼— 2⅜	2¼— 2⅜	...	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5 %	5½%	6 %	4 — 5	4 — 5	...	...
194,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	101 —103	101 —103	...	...
110,000	Electric Construction, 1 to 110,000	2	5 %	6 %	6 %	2⅛— 2⅜	2 — 2¼	2 1/16	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	2⅜— 3⅛	2⅜— 3⅛	2⅜	...
111,100	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	105 —107	105 —107	106½	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	⅝— ⅝	⅝— ⅝	...	...
67,275	Elmore's Wire Manufacturing, 1 to 69,385, issued at 1 pm.	2	...	...	...	½— ½	½— ½	...	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	10½%	7 %	7 %	10 — 12	10 — 12	...	...
12,500	Henley's (W. T.) Telegraph Works, Ord.	10	8 %	10 %	12 %	20½— 21½	20½— 21½	21¼	...
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	18 — 19	18 — 19	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½%	4½%	4½%	110 —115	110 —115	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	22 — 23	22 — 23	...	...
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	102 —106	102 —106	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2⅜ %	2⅜ %	3½%	10 7/16— 10 9/16	10⅜— 10½	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	15½— 16	15½— 16	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	37 — 41	37 — 41	...	...
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	104 —107	104 —107	105	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	...	...	106 —111	106 —111	108	107

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 10⅛.
British Aluminium, Ordinary, 10—12; 7 % Pref., 11—13.
House-to-House, 4½% Debentures of £100, 105—108.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 13—14; 1st Preference Cumulative 6%, £5 (fully paid), 7⅜—8¼. Debentures, 105—108. Dividend, 1897, on Ordinary Shares 10%.
National Electric Free Wiring, 10s. paid, 5/16—7/16.
Smithfield Market Electric, 3—4.
*T. Parker, £10 (fully paid), 14—15.
Yorkshire House-to-House Electricity, £5 Ordinary Shares fully paid, 7⅜—8¼. Dividend for 1896—6%.

* From Birmingham Share List.

Bank rate of discount 4 per cent. (October 13th, 1898).

MARKET QUOTATIONS, Wednesday, November 2nd.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a ,, Nitric .. .. .. per cwt.	22/-	22/-	..
a ,, Oxalic .. .. .. per cwt.	32/-	32/-	..
,, Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per ton	37/-	37/-	..
a Ammonia, Muriate (grey) .. per ton	£19	£19	..
a ,, ,, (white) .. per ton	£26	£26	..
a Bleaching powder .. .. per ton	£6 15	£6 15	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. per ton	£14 10s.	£14 10s.	..
a Benzole (90 %) .. .. .. per gal.	7/-	7/-	..
a ,, (50/90 %) .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£18 10s.	£18	10s. inc.
a Lead, Nitrate .. .. .. per ton	£23 10s.	£23 10s.	..
a ,, White Sugar .. .. per ton	£30 10s.	£30 10s.	..
a ,, Peroxide .. .. .. per ton	£27 10s.	£27 10s.	..
a Methylated Spirit .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.) .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	8¾d.	8¾d.	..
a ,, Caustic (75/80 %) .. per ton	£24	£24	..
a ,, Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. per cwt.	65/-	64/-	1s. inc.
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6 10	£6 10	..
a ,, Recovered .. .. per ton	£5 10	£5 10	..
a ,, Lump .. .. .. per ton	£5	£5	..
a Soda, Caustic (white 70 %) .. per ton	£8 15	£8 15	..
a ,, Crystals .. .. .. per ton	£3	£3	..
a ,, Bichromate, casks .. per lb.	3d.	3d.	..

METALS, &c.	This week.	Last week.	Increase or Decrease.
b Aluminium Wire, in ton lots .. per ton	£224	£224	..
b ,, Sheet, in ton lots.. per ton	£191	£191	..
c Brass (rolled metal 2' to 12') basis per lb.	6¼d.	6¼d.	..
c ,, Tube (brazed) .. .. per lb.	8¼d.	8¼d.	..
c ,, Wire, basis .. .. per lb.	6¾d.	6¾d.	..
f Ebonite Rod .. .. .. per lb.	3/-	3/-	..
f ,, Sheet .. .. .. per lb.	5/-	5/-	..
g Copper Bars .. .. .. per ton	£65	£64	20s. inc.
g ,, Wire (basis price) .. per lb.	7¾d.	7¾d.	..
g ,, Sheet .. .. .. per ton	£65	£64	20s. inc.
g ,, Rod .. .. .. per ton	£65	£64	20s. inc.
n German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	5/6	5/6	..
h India-rubber, Para fine .. per lb.	4/- forw'rd	3/10½ forw'd	1½d. inc.
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i ,, Pig (Cleveland warrants) per ton	47/7½	45/10	1/9½d. inc.
i ,, Forgings, according to size per ton	From £11	From £11	..
i ,, Scrap, heavy .. .. per ton	45/-	45/-	..
i ,, Wire galvanised No. 8 .. per ton	£8 15	£8 15	..
g Lead, English Ingot .. .. per ton	£13 15	£13 5	10s. inc.
g ,, Sheet .. .. per ton	£14 15	£14 2 6	12/6 inc.
l Mica (uncut slabs 8" long) .. per lb.	5/6	5/6	..
m Manganin Wire No. 28.. .. per lb.	8/-	8/-	..
g Mercury .. .. per bottle	£7 4	£7 4	..
o Platinum .. .. per oz.	£2 16	£2 16	..
i Steel, Magnet, according to description .. .. .. per ton	From £15	[illegible] to £40	..
i Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. per ton	£86	£83 to £84	40s. inc.
g ,, foil .. .. per lb.	1/4	1/8	1d. inc.
n ,, wire Nos. 1 to 16 .. .. per lb.	1/4	1/4	..
j Yarns, Cotton, Single 10lb. bundles pr lb.	6¾d.	6¾d.	..
j ,, Flax, 6 or 8 lea... .. per lb.	8¾d.	8¾d.	..
j ,, Hemp, 3 ply 10 lbs. .. per lb.	3¾d.	3¾d.	..
j ,, ,, Russian, 10 lbs. per lb.	4¼d.	4¼d.	..
j ,, Jute, 180 lbs. rove .. per ton	£12	£11 10	10s. inc.
j ,, Manila, 24 thread .. per ton	£30	£30	..
k Zinc, Sheet (Vielle Montagne bnd.) p. t.	£28	£28	..

a Quotations supplied by Messrs. G. Boor & Co.
b ,, ,, ,, The British Aluminium Co., Ltd
c ,, ,, ,, Messrs. Thos. Bolton & Sons.
d ,, ,, ,,
e ,, ,, ,,
f ,, ,, ,, The India-Rubber, G.-P., and Teleg. Works Co Ltd
g ,, ,, ,, Messrs. James & Shakspeare.
h ,, ,, ,, ,, Jackson & Till.
i Quotations supplied by Messrs. Bolling & Lowe.
j ,, ,, ,, ,, Henry C. Yeo & Co.
k ,, ,, ,, ,, Morris Ashby, Limited.
l ,, ,, ,, ,, Sanders, Wake & Co.
m ,, ,, ,, ,, W. T. Glover & Co., Ltd.
n ,, ,, ,, ,, P. Ormiston & Sons.
o ,, ,, ,, ,, Johnson, Matthey & Co., Ltd.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, BRISTOL, 1898.

EXPERIMENTS ON THE INFLUENCE OF ELECTRICITY ON GROWING VEGETABLES OR PLANTS.

By Selim Lemström,
Professor of Physics at the University of Helsingfors.

Read before Section A.

Introduction.

It is a well-known fact that the question which is the object of this paper has been a favourite field of investigation for a century past. Many scientists have regarded it as already fully exhausted, and consider further researches as more or less superfluous. As the subject is connected with no less than three sciences, viz.: physics, botany, and agricultural physics, it is in itself not particularly attractive.

The causes which have induced us to begin an investigation of this matter have been manifold. We venture to hope that a short exposition of them will not be without interest.

During several voyages in the Polar regions (1868 to Spitzbergen and the north of Norway, and 1871, 1882, 1884 to Finnish Lapland), we have had occasion to observe with our own eyes in the vegetable kingdom a peculiarity which also has attracted the attention of other explorers. When the plants in these regions have happily resisted the frequently destructive night frosts, they show a degree of development which greatly surpasses that of plants in more southern regions, where the climatic conditions are more advantageous. This rich development appears principally in the fresh and clear colours of the flowers, in their strong perfume, in the rapid development of the leaves on the trees and their scent, but particularly in the rich harvest, which the different seeds, such as rye, oats, and barley, will produce when, as before stated, they are not destroyed by the frost. From a bushel of rye sown they will often produce 40 bushels, and from barley 20 bushels, and so forth. It is the same with grass. These results are attained, although the people cultivate their soil very imperfectly, using ploughs and harrows of wood without a bit of iron.

The vegetables require, for a rich development, a fertile soil and a sufficient quantity of heat, light, and humidity; but one of the principal conditions, that of heat, is to be found in the Polar regions only in a slight degree. To be convinced of that, it is only necessary to glance at a map and follow the yearly isothermes, and especially the summer isothermes. The isotherm corresponding to a mean temperature of − 7° C. to − 8° C. *crosses* Spitzbergen, and that of 0° goes through the north of Finnish Lapland. The mean temperature for the month of July is there 10° C., and at Spitzbergen 5° C.

The cause of this astonishing development has hitherto been regarded to lie in the long day, which lasts from two to three months in these regions during their short summer. It is further supposed that this circumstance will procure them more light and heat, the principal factors of vegetation. This is, however, not true, for a calculation shows that the quantity, notwithstanding this long day, is less than, for instance, in 60° of latitude. In consequence of the low height of the sun over the horizon, the rays meet the earth in such an oblique direction that their illuminating and heating power is greatly lessened, and this power is also lessened by the great absorption in the atmosphere. But since the quantities of light and heat received are relatively smaller than in more southern regions, the cause of the rich development of the vegetables cannot lie in the long day, and it must be sought elsewhere.

For several reasons we were induced to search for the cause in electrical currents, the effect of which appears in the Polar light, and which is going from the atmosphere to the earth or *vice versâ*. The existence of these currents has been proved beyond all doubt through the experiments of the Finnish International Polar expedition 1882-84.

Our reasons will be shown in the following order:—

(*a*) The physiology of plants gives a satisfactory explanation of the functions which most of their organs have to perform, and good reasons for their existence and their varying forms. This is, however, not the case with the needle-like shape of the leaves in fir trees, and the beard on the ears of most cereals. Since nothing exists without a purpose in all the infinite number of objects in nature, then the needle-shaped leaves and the beard must have their determined ends. In fact, they are very well fitted to be the means through which the electricity goes from the atmosphere into the earth, or *vice versâ*; that is to say, they act in the same fashion as metallic points. To pretend that they really serve as a means of transmitting electricity only because their form shows them capable of it, would be to go too far. The presence of electricity in the air around these pines shows that they are, in fact, in a position to perform this function of transmission. Through experiments made during the above-named expedition, it was at least, by analogy, proved that they really serve that end, for it was not only shown that such electrical currents exist, but these currents were even measured by means of a specially constructed apparatus provided with metallic points.

We are thus induced to concede that an electrical current is going on through the needle-formed leaves of the pine, and the beard on the ears of cereals, not to speak of other plants. Though this is the case, it is not, however, shown that this electrical current exercises any influence whatever in the process of vegetation, or, in other words, has any definite effect on the plant life itself. That must be proved by experiments, and will be the principal object of our present exposition.

(*b*) In studying and observing sections of fir trees from different latitudes (60°—67°), we have found a peculiarity in their yearly growth in thickness or year rings. They show in general a great difference in growth during different ages, but when due regard is paid to this fact, so that these differences will be eliminated, there remains another difference, which clearly must depend on the more or less advantageous nature of the year.

These later variations, regarding principally the thickness of the year rings, show a periodicity in full agreement with the periods of the sun spots and the auroras, namely, a period of from 10 to 11 years. By a comparison between sections of large pine trees from the Polar regions of lat. 67° and from more southern latitudes (about 60°), it will be seen that this periodic variation is much more pronounced the more nearly we approach the Polar regions. The circumstance that this periodicity agrees with that of the auroras, will conduce to an investigation of a possible connection between the electrical current producing auroras and the yearly growth of the year rings of these trees. As this peculiarity is more strongly developed in those regions of the earth where the electrical currents in question are of greater frequency and higher intensity, it indicates a connection between cause and effect, which in a still higher degree demands an investigation.*

(*c*) In a short paper entitled, "On the Periodic Variations in some Meteorological Phenomena, their Connection with the Changes of the Solar Surface and their Probable Influence on the Vegetation," the author has suggested with a high degree of probability that the harvest results in Finland show a periodicity which agrees with the periodical variations in the sun spots and in the number of Polar lights.

The greater the yearly number of sun spots and auroras, the more abundant is the harvest of seeds, roots, and grass.†

In the paper in which we treat these phenomena, we have found the explanation of this periodicity in the different state of the heat radiating from the sun, either without spots, or supplied with them. In the former case a greater part of the heat rays are light, and of shorter wavelength; in the latter case the greater number are dark, and of greater wave length. The rays must pass through the atmosphere, and the darker heat rays will be absorbed during this passage rather than the lighter ones, and hence there will be more heat stored up in the atmosphere in the case when spots appear on the sun. This heat, generally contained in watery vapours, is transported through the air currents or winds into higher latitudes, and will there exercise its beneficent effect. Though we continue to regard this explanation as highly probable, we must introduce a little modification, in order to ascribe a large influence to the Polar light, or rather its cause, the electrical current from the atmosphere.

In consequence of this modification of our ideas, we must give it an important place in order to explain the periodicity of the harvests. Everyone who has given a little attention to the question of the causes of the electrical conditions of the atmosphere, knows that several theories on this matter have been brought forward. The most widely known suppositions are the following:—

(*a*) Unipolar induction caused by the earth, as a magnet, rotating around its axis, produces a force component, which carries the positive electricity up in the atmosphere.

(*b*) Evaporation, which, according to the opinion of several physicists, produces electricity, the vapours being positive.

(*c*) Unipolar induction working together with the evaporation in making every particle, great or little, carried from the earth, positively electric.

(*d*) The vegetation process on the earth, the friction of the small solid or liquid particles suspended in the atmosphere with the air, or between each other, the air's friction against the surface of the earth.

(*e*) The direct effect of the sun rays on the different layers of the atmosphere.

A discussion of these very different views cannot be entered upon here. We will only say that the majority of the physicists, as it seems to us, are at present inclined to give a certain precedence to the opinion which searches for the cause of the atmospheric electricity in the evaporation which is going on all over the earth (perhaps in connection with the unipolar induction). For our part, we have no doubt that this conception is right, viz., that the watery vapours act as transmitters of the atmospheric electricity and carry it to the upper layers of the air, because it seems to us very well founded and in full harmony with other closely allied phenomena.

According to the opinion above stated, the evaporation must be subjected to the same periodicity as the sun spots and also the electrical phenomena. Our opinion on the way in which nature is fulfilling whole this process is shortly:‡

The quantities of electricity which are carried up by the water vapours to the higher parts of the atmosphere, attain there a space of air with a low pressure. As this rarefied air is provided with a relatively high conducting power, it will form with the surface of the earth a nearly spherical condenser. The rarefied air space lies principally in consequence of the lower temperature, nearer to the earth surface around the poles. Through this circumstance a greater quantity of electricity will accumulate in these regions, and there discharge in auroral displays or in a current from the atmosphere.

It has already been mentioned that the Finnish International Polar expedition produced, by experiments made on mountain tops, auroral beams and light phenomena of the same nature as the auroras, and hence contributed to the confirmation of the opinion that auroras are caused by electric currents in the atmosphere. The E.M.F. of this current was measured. It was absolutely very little, but *always*

* This investigation is not yet published.

† The longer period of about 58 years seems also to exist in these harvest results.

‡ See "L'Aurore Boreale," par S. Lemström. Paris: Gauthier, Villars, 1886, p. 131 and following.

existing, though with varying intensity. It is only in exceptional cases that it will produce light phenomena, viz., when the circumstances in the atmosphere are favourable and the current is of high intensity. The most important result is here the proof of the existence of such a current, which is always going on, either downwards or upwards.

When the experiments have been carried out in Finnish Lapland, they do not, strictly speaking, apply to other regions of the earth. Considering, however, that the laws of atmospheric electricity are nearly the same for all latitudes, the existence of such a current in the whole atmosphere seems not to be doubted.

This electric atmospheric current has hitherto been very little investigated, and it is only the atmospheric electricity which has been measured. The method has been to measure the potential in a point of the air (or the electrical tension of it). These results cannot be used for conclusions regarding electrical current from the atmosphere, and in consequence not for the laws it follows. These observations of the atmospheric electricity can, however, contribute to some general propositions. When it has been found, for instance, that the air near the earth surface is positive electric (seldom negative), and that the potential increases with the height, a general conclusion can be drawn that an electric current, an equalising of the difference of potential, is going on between the whole atmosphere and the earth.

As has been said above, this current produces luminous phenomena or Polar light only when in a state of high intensity. When these appear principally in the Polar regions, it must be admitted that the current there possesses the highest intensity. The effect of it must therefore be more remarkable there than elsewhere.

Once convinced not only of the necessity for finding a cause for the above-mentioned phenomena of the vegetable kingdom in the Polar regions, but also for the existence of the electric current from the atmosphere, we were strongly induced to connect the two phenomena, and to regard the electric current as the cause of the peculiar phenomena in the vegetation, and all that has been said about these peculiarities will find its explanation in it:—(1) The rich harvests and their periodicity; (2) the periodical increase in the year rings of the fir woods, and (3) the needle-formed leaves, and the beards of the ears will, from this point of view, only be the means by which the electricity is conducted from the atmosphere to the earth. When the intensity of the current is highest in the Polar regions its effect must also there be the greatest.

It must not be forgotten that the electricity has hitherto been regarded as of none or little importance in the complex life of the plant, and a great action of it was not to be expected. From the further representation of the matter, it will, however, be clear that this conception must be changed, and that it must be numbered among the principal factors in the life of vegetables.

Short History.

In our days the science cannot be satisfied with conclusions of more or less probability. It demands decided proofs, if they are to be obtained, and in the present case it lies within the limits of possibility.

Before we go to the experiments, it will be convenient and necessary to look at that which has been produced in times gone by.

From the middle of the eighteenth century, or from 1746, this question began to be treated. It was a Scotchman, Mowbray, who probably was the first to occupy himself with it. He published the results of experiments on two myrtles put under the influence of electricity. They showed a much more rapid and stronger development than other plants of the same kind in the vicinity not influenced by electricity. These experiments attracted attention, and induced imitation.

All the experiments which, during bygone times, have been made, cannot even approximately be considered here, but only the chief points in them.

Two ways can with certainty be marked, viz.:—

(*a*) The experiments were made with the view of using the atmospheric electricity, facilitating by different means the current of electricity from the air through the plants.

(*b*) Artificially produced electricity, viz., by a machine, is brought to exercise its effect on the plants.

Of course, other plants were used for comparison, or as control, in both cases.

The most striking features in these experiments is, that they are *always contradictory*. Hardly has one explorer received favourable results before another presents himself with directly opposite ones. As an instance, we may cite the experiments which were performed (1878-79) by Grandeau, Leclerc, and Celi on the one side, and by Ch. Naudin on the other side.

In surrounding plants with cages of wire, Grandeau and Leclerc sought to shut out the atmospheric electricity, and found that it exercised a most unfavourable effect upon the plants. Grandeau tells us that when the atmospheric electricity has free access, the effect will be an increase in the harvest of

Leaves and stalks from 50 per cent to 70 per cent.
Of seeds and fruits from 50 per cent. to 60 per cent.

In this result Leclerc agrees with Grandeau. Celi performed one good experiment on Indian corn, in which he accumulated the electricity of the air, and let it exercise its effect on a plant under a glass bell, the plant, with which it was compared, being also under a bell of glass. The following year, 1879, Ch. Naudin published an account of experiments in which he obtained directly opposite results, the plants under wire cages showing a much better development than the other plants in the neighbourhood.

These contradictory results are, as above mentioned, characteristic. A closer scrutiny shows that a favourable result is received every time the experiments are executed with artificial electricity, namely, with a machine. Exception shows only one case in which negative electricity was employed.

The experiments have never been executed on a larger scale because the method was not convenient. In the case when the method was intended to spread the electricity over a larger field (Bertholon), its application seemed to present much difficulty.

The cause of the contradictory results has been searched for: in circumstances of only occasional occurrence, for instance, difference in the soil, different illumination, &c. Without denying that such circumstances can exercise a very great influence, our more lately-gained experience has, however, shown that they can obtain their explanation without referring them to chance.

A consideration of all the experience we had gained showed so decidedly that the electricity exercised a favourable influence on the growing plants, that we found a new examination of the question necessary.

(*To be continued.*)

THE INSTITUTION OF CIVIL ENGINEERS.*

Abstract of Presidential Address of William Henry Preece, C.B., F.R.S.

The election to the position of President is the highest possible reward which the Institution can give to those who have endeavoured to serve it well and truly. I have often feared that my position as a specialist might have proved a bar to the attainment of my greatest ambition. It has come at last. I am very grateful, and I promise that I will continue to do my very best to merit your confidence and approbation. I am also proud, not alone for the sake of that branch of the profession to which I specially belong, but also because I am a member of the great Civil Service of this country.

I entered the Institution as an associate in 1859, and am now in my fortieth year of membership. It is interesting to see the growth of the Institution during that period:—

Roll of the Institution of Civil Engineers.

——	November, 1859.	October, 1898.
Honorary members...	25	20
Members	332	1,946
Associate members...	...	3,940
Associates	523	320
Graduates	14	...
Students	...	862
Total... ...	894	7,088

The distribution of our 7,088 members over the globe is shown in this Table:—

Distribution Table.

——	United Kingdom.		India with Ceylon and Burma.	South and East Africa with Transvaal.	Australasia.	Canada with British Columbia, Nova Scotia, and Newfoundland.	British Possessions—Miscellaneous.	United States.	Other Countries.
	Resident.	Non-Resident.							
Hon. members.....	12	4	...	...	...	...	...	1	3
Members.....	555	790	162	50	140	45	25	65	114
Assoc. members...	970	1,690	350	180	270	30	90	45	315
Associates.....	175	100	12	4	8	1	2	5	13
Students.....	275	417	60	20	40	5	20	5	20
Totals	1,987	3,001	584	254	458	81	137	121	456

The field of the profession has extended in all directions by the advances of practical science and by a process of evolution and agglutination. We have the railway engineer, the mechanical engineer, the naval architect, the mining engineer, the sanitary engineer, the gas engineer, the hydraulic engineer, the electrical engineer, the chemical engineer, the marine engineer, species of one genus—the civil engineer, whose home is in this building, whose Institution, like a good mother, tries to keep them all under the protection of her wings, and who is prepared to make any sacrifice to advance the knowledge of engineering, and to maintain the solidarity and reputation of the profession. The engineering conference held by the Institution in 1897 was undertaken in the furtherance of this aim, with results so successful as to call for its repetition in the approaching spring of 1899.

* Delivered Tuesday, November 1st, 1898.

Examinations.

Our great European rivals relegate the examination and selection of their engineers to their Governments, but we, under the guidance of our immediate past-president, have taken this load on our own shoulders—not before it was needed, for the competition of highly educated engineers of other countries was becoming rather too evident.

Hence the Institution, as the tutelary genius of the profession, has established a system of qualifying, not competing, examinations for admission into its ranks, not only to test the education and preparation of those who wish to recruit our numbers, and the qualifications of those who desire to improve their position in our classes, but also to enhance the standing of the modern engineer as the most scientific and advanced of all the learned professions. The result of the first examinations has been highly satisfactory. Out of 24 examined for studentship, 3 only failed to pass. Of 40 examined for associate membership, 7 failed. Of 48 theses submitted in lieu of examination, 5 only failed to secure a satisfactory report. The popularity of the measure among even the examinees is shown by the entrance of 71 for this last October examination.

The examination papers which have been set are by no means of an insignificant character, yet 86 per cent. of marks have been acquired on the whole examination.

A mere University training alone does not lead to invention and discovery. It is contact with the practical world, a knowledge of wants and defects, which excite discoveries and improvements. The modern method of research proceeds by making experiment subservient to hypothesis. Difficulties teach effects, effects suggest causes, a knowledge of causes leads to remedies, and finally to exact science. Practice, the home of difficulty, is thus the nursery of science. The engineer is far in advance of the pure scientist. Smeaton and Watt, Telford and Stephenson, Rankine and Kelvin, Whitworth and Froude, Regnault and Hirn, have established not only the profession of the scientific engineer, but they have laid the groundwork of science itself.

Technical Education.

The modern engineer has immense advantages over his predecessors. He can commence his practical career with a University training, well charged with facts, wanting only that experience which practice alone will give.

There is a fashion in Great Britain for technical education just now. Enormous sums of money are being annually spent on secondary, intermediate, and more advanced education. It is well that it is so. It is well that the country has awakened from its conservatism and apathy, and that it is putting its schools in order. But is it doing so on a true issue, and are we distributing our money through the right channels? Our trade is suffering even in our own colonies from the competition of our Continental neighbours, who are said to be beating us by their technically superior hand labour. It is true we are suffering, but is this the true cause? It is rather from the superior commercial skill of the principals at home and the accomplished polyglot and well-trained traveller abroad, as well as from a financial system that is more moral and more sound than that rampant in England through the gross abuses of the Limited Liability Act of 1862. Our law courts are almost daily the scenes of the exposure of the modern spoiling of the Egyptians. A new industry is designed by some simple, well-devised, and economical process. Capital is required to develop it. In Germany, financial support is readily subscribed by the generous and enlightened policy of its banks. In England we require a syndicate, a pioneer company, and finally an appeal to the public for an enlarged limited company. The financiers, the lawyers, the brokers, as well as the original inventor, have to be satisfied, and this satisfaction grows very much with the state of the money market and the excitement for investment with the public. The industry is established, but with a terribly overloaded capital—overloaded by the harpies who have sprung from the operations of the Limited Liability Act. The same industry could be established in Germany with probably half the capital. Its manufacture would be supervised there with greater skill, and it would be developed as a business by better trained agents. We are thus fairly beaten on our own commercial preserves.

Our educational methods have begun at the wrong end. We ought to teach the masters first, and then the men. Moreover, we have to teach the teachers and those who have control of the purse-strings. The County Councils of England are scarcely qualified as yet to discharge the very serious duty of properly dealing with a question so few of them understand—though many of them have tackled the matter manfully, especially the London County Council, through its Technical Education Board, on which a large proportion of co-opted experts have seats, who, by supporting existing institutions, have contributed towards the supply of teachers. But how are we to approach the masters? A fault once discovered is half-way to repair. It is difficult to remove the scales from the eyes of the man who has been successful in business, and who knows not of his blindness; but the coming generation will be more enlightened, and the future masters better educated.

We are suffering from a lack of competent teachers. A teacher who has had no training in the practical world is worse than useless, for he imparts ideas derived from his inner consciousness, or from the false teaching of his own abstract professor, which lead to mischief. In my own experience I have met with very serious inconveniences from this cause. The ideal professor of pure abstract science is a very charming personage, but he is a very arrogant and dogmatic individual, and being a sort of little monarch in his own laboratory and lecture room, surrounded by devoted subjects, his word is law, and he regards the world at large, especially the practical world, as outside his domain, and beneath his notice. He is generally behind the age. These are not the men for technical institutes. Such teachers should possess the diploma of this Institution.

Energy.

The great generalisation of modern days is the principle of the conservation of energy. Energy, like matter, can neither be created nor destroyed. Its form only can be changed. It is in its various transformations that it expends or absorbs work, and thus the engineer has to consider not only the various forms of matter, but the various forms of energy. He has to expend energy on matter in such a way as to supply the wants, improve the comforts, and add to the resources of mankind. Every branch of engineering is thus dominated by the application of the great principle of work, which means the expenditure of energy, for energy is simply the capacity or property which Nature possesses for doing work.

Electricity.

Day by day we are startled with some new development of electricity. We have learned the truth of the aphorism that that which is sure to occur is the unexpected.

I learned from Faraday to regard electricity as the result of the play of the atoms and molecules of matter, that it was a mere form of motion, and that its influence through space was due to the existence and operations of a medium—since called the ether. Maxwell crystallised Faraday's views into mathematical language, and deduced the magnificent generalisation that light and electrical waves are of the same kind, moving through the ether with the same velocity, and differing from each other only in degree. Hertz proved the existence of these waves, and measured their lengths, and Marconi has now applied them to the practical purposes of telegraphy. I have carefully watched every new electrical fact wrung from Nature's storehouse without ever failing to find a simple mechanical explanation of their cause.

The term "electricity" has even been defined by Act of Parliament (45 Vic. cap. 56, 1882) as that form of energy which we make and sell. It can be measured with the minutest engineering exactness, and its effects are explicable on the simple dynamical and mechanical principles that underlie our profession.

Lightning.

The first practical application of the science of electricity was for the protection of life and property. Franklin, in 1752, showed how to secure ourselves and our buildings from the disastrous effects of a lightning stroke. Very little has been done since to improve upon his plan. A Lightning Rod Conference, upon which I served, met in 1878, and its report, published in 1881, remains an admirable and useful standard of reference. The principle advocated by Franklin was prevention rather than protection. If a building or a ship be fitted and maintained with good continuous copper conductors, making a firm electrical contact with the earth or the sea, and be surmounted well up in the air with one or a cluster of fine points, all the conditions that determine a charge of atmospheric electricity and a flash of lightning are dissipated silently away and no terrible discharge is possible. A mischievous and baseless delusion is prevalent that protectors actually attract lightning, and may be sources of danger. Every exposed building should be fitted, but a well protected dwelling house is the exception not the rule. Even when protectors are fixed, apathy leads to their imperfect maintenance. Their failure to act is always traceable to the neglect of some simple rule. Carelessness is the direct disease we suffer from. Telegraph and telephone wires which spread all over our towns and country are very much exposed to the influence of atmospheric electrical effects. Every instrument is now protected. Every telegraph pole has a lightning conductor. Accidents are rare, and the system itself is a public safeguard. In some countries like California and South Africa thunder-storms are very frequent and very severe, but their effects have been tamed.

Franklin's work has been beneficient. He showed successfully how to bring the lightning down from heaven and how to dissipate its causes harmlessly away in the earth.

Telegraphy.

In 1837 Cooke and Wheatstone showed how electricity could be practically used to facilitate intercommunication of ideas between town and town and between country and country. The first line was constructed in July of that year upon the incline connecting Camden Town and Euston Grove Station, the resident engineer being Sir Charles Fox, father of the senior Vice-President. Five copper wires were embedded in wood of a truncated pyramidal section and buried in the ground. The instrument used possessed five needles or indicators to form the alphabet. A portion of this original line was recently recovered *in situ*. I call it the "fossil telegraph," and used it to complete a special circuit between Buckingham Palace and the General Post Office, to enable the Queen on her Diamond Jubilee day, as she started on her procession through London, to telegraph her simple message, "From my heart I thank my beloved people. May God bless them!" to all our princes, governors, captains, and rulers scattered over the whole globe.

The pioneer line of 1837, 1½ mile long, has, during this period of 60 years, grown into a gigantic world-embracing system. Every man at his breakfast table can read an account of every stirring event that has transpired on the previous day in every quarter of the world. Distance is annihilated, and time overcome.

The extent of the present system of British telegraphs is shown by the following table:—

	Miles of wire.
General Post Office and its licensees	435,000
Railway companies	105,000
India and Colonies	387,966
Submarine cables	183,400
Total	1,111,366

The mechanical construction of the telegraphs of this country was designed by our late distinguished member, Edwin Clark, and his brother, Latimer Clark, also a member. Their affairs were originally directed by our Past-Presidents, Robert Stephenson, Bidder, and Locke. We in this country have always been in advance of other countries in telegraphic progress, and this was greatly due to the inventive genius of Cromwell Varley, a member of the Institution. These are men under whom I served and learnt, and whose engineering traditions I have done my best to maintain and to better. Progress has never been checked. The speed of signalling and the capacity of working have been increased sixfold, and wires can now be worked faster than messages can be handled by the clerical staff.

The form of submarine cable and the nature of the materials used in its construction have varied but very little since the first cable was laid in 1851. The recent invasion of our channels and seas by the *Limnoria terebrans*, a mischievous little crustacean which bores through the gutta-percha insulating covering, and exposes the copper conductor to the sea-water, leading to its certain destruction, has led to the use of a serving of brass tape as a defence. It has proved most effective.

No one has done more than Lord Kelvin (honorary member) to improve the working of submarine cables. His recording apparatus is almost universally employed on long cables. By the duplex method of transmission the capacity of cables has been practically doubled, and this has been still further improved by applying to cables the system of automatic working, which is such a distinguishing feature of our Post Office system. The number of electrical impulses which can be sent through any cable per minute is dependent upon its form, and is subject to simple and exact laws, but it varies with the quality and purity of the materials used. There is no difficulty in maintaining the purity of copper. Indeed, copper is frequently supplied purer than the standard of purity adopted in this country—known as Matthiessen's standard. The purity of gutta-percha is, however, questionable. The supply of this dielectric has dwindled; it has failed to meet the demand; its cultivation has been neglected. The result is a dearth of the commodity, a great increase in price, and its adulteration by spurious gums. India-rubber, its sole competitor for cables, is being absorbed for waterproof garments and pneumatic tires, but for underground purposes paper is being used to an enormous extent. Paper has the merit, when kept dry, not only of being an admirable insulator, but of being very durable. There is paper in existence in our libraries over 1,000 years old. The difficulty is to keep it dry. This is one of the problems the engineer delights to consider. He has been most successful in obtaining a solution. The lead-covered paper cables, which are being laid in the streets of all our great cities, are admirable. I am laying one of 76 wires for the Post Office telegraphs between London and Birmingham, and the cable companies are contemplating leading their long cables from Cornwall up to London, so as to be free from the weather troubles of this wet and stormy island.

It is impossible to forecast the future of telegraphy. New instruments and new processes are constantly being patented, but few of them secure adoption, for they rarely meet a pressing need or improve our existing practice. The writing telegraph originating with our late member of Council, E. A. Cowper, which reproduced actual handwriting, much improved by Elisha Gray, and called the "Telautograph," is steadily working its way into practical form, and electrical typewriting machines of simple and economical form are gradually replacing the A B C visual indicator. The introduction of the telephone is revolutionising the mode of transacting business. There seems to be a distinct want of some instrument to record the fleeting words and figures of bargains and orders transmitted by telephone. Hence a supplement to that marvellous machine is needed. The telautograph and electrical typewriter will fill this want. Visions of dispensing with wires altogether have been fostered by the popularity of Marconi's "wireless telegraphy;" but wireless telegraphy is as old as telegraphy itself, and a practical system of my own is now in actual use by the Post Office and the War Department. Sensational experiments for booming a new financial enterprise are not processes that commend themselves to the Institution. We want practical work and engineering progress.

Telephony.

I was sent in 1877, together with Sir Henry Fischer, to investigate the telegraph system of the American Continent, and especially to inquire into the accuracy of the incredible report that a young Scotchman named Bell had succeeded in transmitting the human voice along wires to great distances by electricity. I returned from the States with the first pair of practical instruments that reached this country. They differed but little from the instrument that is used to-day to receive the sounds. The receiver, the part of the telephone that converts the energy of electric currents into sounds that reproduce speech, sprang nearly perfect in all its beauty and startling effect, from the hands of Graham Bell. But the transmitting portion, that part which transforms the energy of the human voice into electric currents, has constantly been improved since Edison and Hughes showed us how to use the varying resistance of carbon in a loose condition, subject to change of pressure and of motion under the influence of sonorous vibrations. The third portion, the circuit, is that to the improvement of which I have devoted my special attention. Speech is now practically possible between any two post offices in the United Kingdom. We can also speak between many important towns in England and in France. It is theoretically possible to talk with every capital in Europe, and we are now considering the submersion of special telephone cables to Belgium, Holland, and Germany. The progress of the use of the telephone in Great Britain has been checked by financial complications. It fell into the hands of the company promoter. It has remained the shuttlecock of the Stock Exchange. It is the function of the Postmaster-General to work for the public every system of inter-communication of thought which affects the interests of the whole nation. Telephony is an Imperial business, like the Post and the Telegraph. It ought to be in the hands of the State. The public and the press have frequently kicked violently against the present *régime*. Committees of Parliament have sat and deliberated upon the question. The report of the last Committee is now under consideration.

"*Quidquid delirant reges, plectuntur Achivi.*"

Two causes exist to impede this desirable absorption, the fear of being "done" by watered and inflated capital, and the assumed bad bargain made in absorbing the telegraphs in 1869. The former is a mere bugbear. The public does not want to purchase stock. It wants to acquire a plant and business, which can be easily and fairly valued. The latter is a gross fallacy. The business of the telegraph companies—practically an unlimited monopoly—was purchased on absolutely fair terms, viz., 20 years' purchase of the net profits. The sum paid was £4,989,048. The number of messages then sent in one year was about 5,000,000, and the gross income about £500,000. The income has now grown to £3,071,723, the number of messages has reached 83,029,999, and the capital account which was closed in 1891, viz., £10,131,129, including the cost of the Post Office extensions, remained the same. If a syndicate desired now to re-purchase the business and acquire the plant, they would have to find a capital of over £30,000,000. In what respect, then, was the transfer of the telegraphs to the State a failure? Our magnificent system has been built virtually out of revenue, our tariff is very cheap, scarcely a village of any consequence is without its telegraph, our press is virtually subsidised by having its news supplied at much less than cost price; we can rely upon safe and accurate delivery, and upon speedy despatch of messages. We lead the world. There has been no failure, and there was no bad bargain.

The present condition of the telephone business in this country is shown by the following return:—

Telephones in Use.

National Telephone Company (June 30th, 1898) ...	133,498
General Post Office (" ") ...	9,588
Railway Companies (" ") ...	8,933
Total	152,019

(*To be continued.*)

PHYSICAL SOCIETY.

Ordinary Meeting, October 28th, 1898.

Mr. Shelford Bidwell, president, in the chair.

A paper was read by Mr. W. R. Pidgeon, on "An Influence Machine."

The machine, which was exhibited, consists of a pair of glass discs rotating in opposite directions upon a spindle. They are partially covered on one face with narrow radial sectors of tinfoil, each provided with a small brass knob. This face of the disc, including its sectors, is then coated with insulating wax, leaving only the knobs projecting through the wax. Two earthing brushes pass through two insulated fixed inductors, and support them. The inductors are kept charged by exploring points connected to each and placed so as to collect electricity from the revolving discs. By means of brushes, the sectors on each of the discs are successively earthed at the moment they pass the fixed inductors, *i.e.*, at the moment that their capacity is a maximum; and they are made to deliver up their charge to the main collecting brushes at the moment when they are electrically farthest from the inductors, *i.e.*, when their capacity is a minimum. Hence, if there is no loss of electricity in the process, the potential at the collecting brushes is proportionately high. Each sector of a particular disc, as it moves away from its inductor with rising potential, induces a corresponding potential on the sectors opposed to it on the second disc; this action is cumulative. The thick coating of wax restricts leakage to the small area of the contact knobs, so that surface effects of dirt and moisture are minimised.

Capt. J. H. Thomson, R.A., said that apart from its electrical merits, the machine possessed advantages in mechanical construction. He thought there was still room for improvement in this respect. The countershaft should be done away with, and ball bearings should be introduced. The inductor was a distinct improvement; he thought the efficiency might be increased by adding other inductors. Platinum-iridium was the best material for brushes of such machines.

Prof. Ayrton asked what efficiency was obtained with modern influence machines in general.

Capt. Thomson had found that when running a machine by a motor about 80 per cent. of the power was wasted in mechanical friction, of the remaining 20 per cent. a great deal was lost as electrical leakage.

Prof. S. P. Thompson thought it had been pointed out by Mr.

Wimshurst that influence machines did not work well unless there were at least two thicknesses of glass between the inducing and induced conductors. That was why Mr. Wimshurst put his sectors on the outer faces of the glass discs. Mr. Pidgeon had departed from this. The advantage of the narrow spacing of the sectors was not very apparent.

Mr. Wimshurst (abstract of communication): Waxing the discs reduces leakage and increases the output; the wax-coating virtually doubles the numbers of plates. Inductors contribute a further increase to the output. In 1883 Mr. Wimshurst tried thick coatings of shellac, and also duplicating the glass, with, in some cases, sectors upon the second glass to increase the capacity. The output was increased, but the construction lost simplicity. The indifference of Mr. Pidgeon's machine to dirt and dust was a most valuable result.

Mr. Pidgeon, in reply, showed a set of secondary inductors such as Capt. Thomson had just proposed. They improved the output by about 15 per cent., but they were troublesome to keep in order for they increased the tendency to "reverse."

Dr. S. P. Thompson then repeated an experiment discovered by Prof. Righi, on "A Magneto-Optic Phenomenon."

It was originally described in *Roma, R. Accad. Lincei, Atti* 7, *ser* 5, 1898. A substance absorptive of light is submitted to a powerful magnetic field between the pole-pieces of an electro-magnet. The pole-pieces are drilled so that a beam of light from an arc lamp can traverse the gap *along* the magnetic lines. A polarising prism is placed between the arc lamp and the electro-magnet. After having passed through the magnetising apparatus, the beam thus polarised is examined by an analyser. The analyser must be turned to "extinction" before the magnetising current is turned on. If this is done, brightness is restored at the analyser as soon as the magnetic field is established. The substance absorbing the light in the gap may be nitric oxide fumes, or an ordinary spirit lamp sodium flame. The second effect to be noticed is that when the emergent beam is examined, there is a splitting of the lines. Righi explains this by supposing that when light of frequency, n, is brought into a magnetic field and passed *along* the lines of the field, it is split up into two sets of circular waves, a right-handed and a left-handed set, one of which sets is accelerated and the other retarded. There are now two frequencies, n_1, n_2, one a little higher and the other a little lower than n. But since the analyser is adjusted to extinguish n, there is brightness for n_1, n_2. Normally, nitric oxide absorbs green, and red is observed; but when the magnetic field is set up, blue-green light is seen at the analyser; for there are now two different kinds of light being absorbed, one of higher and one of lower frequency than the normal, and what is observed is the complementary spectrum. Again, if a tube of sodium is warmed to a point far short of that which would cause it to emit visible rays, and the vapour is passed into the magnet gap, at the moment when the magnetic field is set up, the D line becomes visible in the observing spectroscope, *i.e.*, the emission spectrum is obtained of a substance which is not actually emitting light.

Mr. Blakesley said that no doubt the analyser was used at the position of extinction for convenience merely. In other positions the eye would be overwhelmed with light.

Mr. Albert Campbell then read a paper on "The Magnetic Fluxes in Meters and other Electrical Instruments."

He has recently undertaken the measurement of the magnetic fluxes and fields in certain instruments, to determine the order of magnitude of the flux density. In other cases the *total* flux is measured; and in the tests on meters, the power lost in the various parts of the instruments is determined. For the measurement of B, the ordinary ballastic-galvanometer method is employed, with an exploring coil. But, for alternating fluxes, two special methods are adopted, in the first of which the exploring coil is in series with a heating coil associated with a thermopile; in the second, a telephone is connected in series with the search coil and a potentiometer resistance strip. A constant current is sent through the strip from the main alternate current circuit supplying the meter or other apparatus; the telephone and search coil therefore forms a shunt to that circuit at the strip. The search coil is put into position in the field to be tested, and the strip is then adjusted to give silence in the telephone. All these methods are described in detail in the paper, and very important deductions are made, especially as regards the influence of the earth's field on instruments generally assumed to be independent of the earth's H. In a few cases, diagrams are given of the fluxes in magnets, showing exactly what proportion of the total flux is effective at the gap.

Dr. S. P. Thompson suggested that as the paper was of great significance to all who were interested in the design of electric meters and other measuring instruments, involving a knowledge of magnetic fluxes and their variation, an opportunity should be given for a full discussion.

The President proposed votes of thanks and adjourned the discussion of Mr. Campbell's paper to the next meeting on November 11th.

MAN KILLED BY 500-VOLT CURRENT.

It has been generally held, says the *Western Electrician*, that an electromotive force of 500 volts is not high enough to force sufficient current through the resistance of the human body to kill a man. A few cases of death from 500-volt shock have been reported, but the attendant circumstances were usually such that doubts remained whether electricity was the sole cause of death, especially as there is a large number of well-authenticated cases where men have taken currents of much higher voltages, even up to 2,000 volts, with but temporary ill-effects. The nature and length of the contact, the direction of the path of the current through the body, and the general vitality of the subject, have so much to do with the fatality of electric shock that the circumstances of each case must be carefully examined before it can be fairly compared with any other. Such examination has shown that deaths solely due to 500-volt currents of electricity are extremely rare. However, one occurred last week in Chicago, about which there seems to be no doubt.

Frank Masterson, 33 years old and unmarried, a lineman of the Chicago Telephone Company, was at work on the forenoon of September 29th, on Western Avenue, near Jackson Boulevard. He was on a pole engaged in taking down a number of telephone and fire-alarm wires which were to be placed underground. An overhead trolley railway runs through Western Avenue at this point. The trolley wires are protected by guard wires, and, through some carelessness, one of the guy wires at the corner, supporting a guard wire, had become slackened just enough to permit a passing trolley with an unusually strong spring to force the trolley wire high enough to make contact with the guy wire. Not every passing car forced the trolley wire high enough to make the contact: the accidental connection was only made occasionally. But it happened that Masterson, standing on one cross-arm and leaning out over another, was manipulating the wires with both hands just at the time a passing car shoved the trolley wire up to the guy wire, with which the telephone wires were then in contact in the lowering process. The unfortunate man made no outcry when the current passed through his body, but he was dead when taken down a few minutes later by some passers-by who noticed the limp body. He was not badly burned. The contact could only have been of slight duration, during the instant the wire was pressed upward by the passing car, but the current passed directly through the body by the arms. Masterson had no reason to suspect the defective guy wire and appears not to have provided himself with insulating gloves or other protection. Mr. E. B. Ellicott, the city electrician, investigated the case and came to the conclusion that the man was undoubtedly killed by the escaping current from the street railway circuit.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1898.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, *to whom all inquiries should be addressed.*

21,829. "Improvements in incandescent electric lamps." J. E. de Mercay. Dated October 17th.

21,835. "Improvements in storage batteries." W. J. Still. Dated October 17th.

21,841. "Improvements in the armatures of multipolar dynamo-electric machines." Siemens Bros. & Co., Limited, R. Dumas and G. S. Grimston. Dated October 17th. (*Complete.*)

21,843. "Improvements in electrical safety fuses." H. C. Hodge. Dated October 17th.

21,866. "Mechanical music instrument with tune combs and interchangeable discs provided with electric carbonic acid or other motor power." L. Huffeld. Dated October 18th.

21,906. "A new or improved switchboard or frame for electro-physical experiments." A. Skrobanek. Dated October 18th. (*Complete.*)

21,941. "An improved electricity meter for registering the amount of current consumed on direct or on alternating current circuits." F. J. Beaumont. Dated October 18th.

21,943. "Improvements in electrical contact breakers." R. Haddan. (The Allgemeine Elektricitäts Gesellschaft, Germany.) Dated October 18th. (*Complete.*)

21,944. "Improvements in multiple electric switches." O. D. Lucas. Dated October 18th.

21,947. "An electric winch suitable for ash hoists and such like appliances." Siemens Bros. & Co., Limited, and E. Holmes. Dated October 18th.

21,961. "Improvements in electric arc lamps specially suitable for projectors." W. M. Mordey. Dated October 18th.

21,974. "Improvements in the electro-deposition of metals." S. O. Cowper-Coles. Dated October 19th.

21,985. "A new and improved screwless casing for electrical wires." J. H. Kraus. Dated October 19th.

21,997. "Improvements in or relating to the reflector fittings of incandescent electric lamps." W. Simpson. Dated October 19th.

22,027. "Improvements in and relating to electricity meters." P. W. Northey and The Electric Motive Power Company, Limited. Dated October 19th.

22,034. "Improved apparatus for nickel plating." W. P. Thompson. (E. Paul, Germany.) Dated October 19th.

22,036. "Improvements in electric arc lamps." H. H. Bigland. Dated October 19th.

22,037. "An improved machine for wrapping thread, silk, and other workable materials around wire rod or cord lengths, especially applicable for wrapping electrical conducting wire." W. P. Thompson. (J. Schmidt, Germany.) Dated October 19th.

22,046. "Improvements in electrical regulating resistances." F. H. Headley. Dated October 20th.

22,070. "Improvements in and relating to galvanic and other batteries." C. Levetus. Dated October 20th.

22,071. Improvements in safety devices for use with electric cables." J. A. Fleming. Dated October 20th.

22,079. "Improvements in carbon holders for dynamo-electric machines or motors." The British Thomson-Houston Co., Ltd. (A. L. Rohrer, United States.) Dated October 20th. (*Complete.*)

22,080. "Improvements in protecting static voltmeters." The British Thomson-Houston Co., Ltd. (E. M. Hewlett, United States.) Dated October 20th. (*Complete.*)

22,081. "Improvements in means for adjusting the reluctance of magnetic circuits." The British Thomson-Houston Co., Ltd. (E. Thomson, United States.) Dated October 20th. (*Complete.*)

22,082. "Improvements in trolley cars for electric railways." The British Thomson-Houston Co., Ltd. (H. Geisenhoener, United States.) Dated October 20th. (*Complete.*)

22,085. "Improvements relating to electric railways." C. H. Myers. Dated October 20th. (*Complete.*)

22,096. "Improvements relating to electric storage batteries." H. C. Bull, F. G. Bate, and B. A. Spaull. Dated October 20th.

22,115. "Improvements in galvanic batteries." E. Baresch, R. M. A. Baresch, E. M. Togler, and W. von Zabern. Dated October 20th.

22,130. "Improvements in electric railways and tramways." W. G. Heys. (J. J. Heilmann, France.) Dated October 21st. (*Complete.*)

22,153. "An improved gauge for testing if stereo, electro, photo-process, and such like blocks are type-high and uniform in thickness, and for other like purposes." W. Carter. Dated October 21st. (*Complete.*)

22,165. "Improvements in electric light message or advertisement indicators." B. S. Weston. Dated October 21st.

22,181. "Improvements in electrical conducting mains." J. S. Highfield and J. M. Cater. Dated October 21st.

22,183. "Improvements in electric arc lamps." W. C. Johnson and A. Wunderlich. Dated October 21st.

22,185. "Improvements in apparatus for the separation of liquids from fibrous materials." R. Bodmer and J. Schwarzenbach. Dated October 21st. (*Complete.*)

22,190. "Improvements in joint boxes and switches therefore in connection with concentric systems of electrical conductors." G. Wilkinson. Dated October 21st. (*Complete.*)

22,223. "A phosphorescent button or indicator for use in connection with electric light switches." W. B. Benns. Dated October 22nd.

22,238. "New or improved means for preventing the breaking of the cords of electric incandescent lamp holders and lamps." T. S. Shelving. Dated October 22nd.

22,240. "Improvements in automatic electric cut-outs." A. Eckstein and E. S. Shoults. Dated October 22nd.

22,252. "A telephonic apparatus for use on vessels for determining the position of bodies moving outside of same." M. R. D'Asar. Dated October 22nd. (*Complete.*)

22,259. "Improvements in or connected with electric arc lamps." F. J. Borland. Dated October 22nd.

22,261. "Improvements in methods of and means for manufacturing metal tubing, and in utilising the heating effect of electrical energy in connection therewith." E. E. Ries. Dated October 22nd.

22,282. "Improvements in electric traction especially applicable to tramcars." W. Aubert, jun. Dated October 22nd.

ELECTRICAL PATENTS OF 1884 EXPIRING IN NOVEMBER, 1898.

We are informed by Messrs. W. P. Thompson & Co. that about 86 applications for electrical patents were filed in the month of November, 1884. Of these applications some were never completed, and of those that were only two have been allowed to run their full length of term, viz, 14 years, and being of considerable interest they give short abstracts of them below.

14,723. "Improvements in dynamo-electric machines." C. A. Parsons. Relates to machines having drum armatures intended to be driven at a high speed by engines of the turbine type, the supply of actuating fluid being controlled electrically. The core consists of a number of iron washers arranged on a hollow shaft. At each end of the series are insulating washers followed by brass washers forced up by nuts. The conductors are laid in grooves in the iron washers. Each alternate conductor is bent round the end of the armature along a groove in the insulating washers, and is then passed through a hole in the insulating washer next the nut. The other half of the conductors are bent round in an opposite direction. The ends are connected to the commutator segments so as to form a continuous circuit. The conductors are bound to the commutator by means of a pianoforte wire. The commutator is formed of several rings of gun-metal segments held in position by undercut steel rings. A modified method of winding the conductor is also shown, which is simply bent and passed back through the holes in the end washer. In the regulating apparatus, a soft iron bar is pivoted over the field magnet or an independent magnet which tends to turn it against a spring. Its spindle carries an arm, the end of which variably covers the inlet to a pipe. This pipe communicates with a space between flexible diaphragms, and this space is continuously exhausted by a fan driven by the engine. The diaphragms act through a rod against a spring to control the throttle valve, according to the current or electromotive force. Provision is made for preventing the engine from running at an excessive speed through accident.

15,648. "Improvements in dynamo-electric machines." W. Mather, J. Hopkinson, and E. Hopkinson. Relates chiefly to machines having ring armatures. The cores and pole-pieces of the field magnets and the armature cores are of large section. The bounding surfaces of the pole-pieces are approximately parallel to the lines of magnetic induction. When the cores are of wrought-iron and the pole-pieces of cast-iron, the former are led into the latter, and the section of the cast-iron parts is increased. The field consists of two magnetic circuits. The armature is supported on a hub so as to leave the interior open. The cores are let into the pole-pieces. By means of screws, the parts of the cores through which the induction passes are pressed against the pole-pieces. Small extensions of the pole-pieces nearly surround the armature to prevent sparking at the commutator.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, *price, post free, 9d. (in stamps).*

1898.

4,287. "Improvements in electric arc lamps." H. V. James. Dated February 19th, 1898. Relates to improvements in electric arc lamps of the focussing type, in which the upper, or positive, carbon holder is connected by a chain riding over a sprocket wheel, which is fixed to the side of a disc of greater diameter riding upon a centre pin carried by brackets fixed to the top plate of the frame of the lamp. At the base of the disc is fitted a slipper brake having a rubbing surface of cotton belting. 2 claims.

4,398. "Improvements in electric railways on the sectional conductor system." T. M. Murphy. Dated February 22nd, 1898. Relates to improvements in that class of electric railway system in which the working conductor, the energising switch, the main line, the local circuit, the trolley, and the car are so arranged that the energy of the working conductor is effected by the motor-man setting his controller to first shunt the local circuit through the controller, the trolley, the working conductor (third rail) through the switches to close the main line with the working conductor. 5 claims.

4,910. "Improvements in and relating to primary batteries." C. Koenig. Dated February 28th, 1898. Relates to that class of battery known as primary, in which the generation of the electric current takes place through consumption of one or other of the elements in a fluid electrolyte. It consists of a pot of glass having packed in it a layer of sawdust and upon the sawdust a zinc cylinder and carbon rod are placed. The carbon is held in position by an insulating mass forming a cap for the battery through which tubes permit of the fluid electrolyte being introduced within the battery. 2 claims.

6,235. "Improvements in electrical insulators and method of making the same." J. T. Boch. Dated March 14th, 1898. Relates to a triple petticoat conductor. The inner part of which is made preferably of clay and is moulded with a threaded or other suitable socket for the reception of the supporting post, which may be of wood. The outer part is shaped like a bowl, and is provided with a cross notch on the top for the reception of the electrical conductor, it has side shoulders by which the conductor may be wired down. The intermediate part is also bowl-shaped, and the several parts are moulded so as to fit into each other. 9 claims.

6,989. "Improvements in electrical measuring instruments." E. Weston. Dated March 22nd, 1898. Relates to an instrument for measuring the quantity of current and the potential or voltage. It consists of a base having secured to it two standards, two permanent magnets with their poles oppositely located are supported on cross-bars to which, in turn, is secured a dial plate.

7,577. "Improvements in electrical batteries." M. Stubblefield. Dated March 28th, 1898. Relates to a combined electrical battery and electro-magnet for use with water as an electrolyte, comprising a soft iron core piece and a voltaic couple of copper and iron wire insulated from each other and closely and compactly wound together in separate insulated layers to produce a solid coil body surrounding the soft iron core piece. 4 claims.